



COMMANDER NAVAL SURFACE FORCE
U. S. PACIFIC FLEET
SAN DIEGO, CALIFORNIA 92155

and

COMMANDER NAVAL SURFACE FORCE
U. S. ATLANTIC FLEET
NORFOLK, VIRGINIA 23511

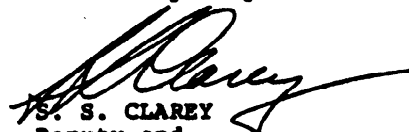
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Subj: COMNAVSURFPAC/COMNAVSURFLANTINST JOINT SURF MANUAL

1. **Purpose.** To promulgate the Joint COMNAVSURFPAC/COMNAVSURFLANT Surf Manual.
2. **Cancellation.** COMNAVSURFPACINST/COMNAVSURFLANTINST 3840.1A.
3. **Information.** The major changes to this instruction include a reorganization of the chapters describing the surf zone, a substantial modification of the Effective Surf Height algorithm, and a new section on LCAC.
4. **Action.** The Joint NAVSURFPAC/NAVSURFLANT Surf Manual furnished herewith, is effective upon receipt. In order that this Manual may best serve the needs of its users, recommendations for changes or additions based on study or personal experience are invited.


J. R. DALRYMPLE
Chief of Staff
COMNAVSURFLANT


S. S. CLAREY
Deputy and
Chief of Staff
COMNAVSURFPAC

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26C2 Beach Group PAC
26D2 SEAL Team and SEAL Delivery Vehicle Team PAC
26E2 Amphibious Unit PAC
26U2 Surface Force Pacific Readiness Support Group
26V2 Landing Force Training Command PAC
26Z2 Shore Intermediate Maintenance Activity PAC
26DD2 Mobile Diving and Salvage Unit PAC
26GG2 Explosive Ordnance Disposal Group and Unit PAC
26QQ2 Special Warfare Group and Unit PAC
28B2 Cruiser-Destroyer Group PAC
28C2 Surface Group and Force Representative PAC
28D2 Destroyer Squadron PAC
28E2 Surface Squadron PAC
28G2 Mine Group and Division PAC
28J2 Service Group and Squadron PAC
28L2 Amphibious Squadron PAC
29A2 Guided Missile Cruiser PAC (CG) (CGN)
29E2 Destroyer PAC (DD), 963 Class
29F2 Guided Missile Destroyer PAC (DDG)
29G2 Guided Missile Frigate PAC (FFG)
29H2 Frigate PAC (FF) less 1040/1097 Class
29J2 Frigate PAC (FF) 1040/1051 Class
29K2 Frigate PAC (FF) 1052/1077 Class
29L2 Frigate PAC (FF) 1078/1097 Class
29R2 Battleships PAC (BB)
29AA2 Guided Missile Frigate PAC (FFG) 7 Class
29BB2 Guided Missile Destroyer PAC (DDG) 993 Class
30A2 Minesweeper, Ocean (Non-magnetic), PAC (MSO)
31A2 Amphibious Command Ship PAC (LCC)
31B2 Amphibious Cargo Ship PAC (LKA)

COMNAVSURFPAC/
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2 JAN 1987

31G2 Amphibious Transport Dock PAC (LPD)
31H2 Amphibious Assault Ship PAC (LHA) (LPH)
31I2 Dock Landing Ship PAC (LSD) 41 Class
31J2 Dock Landing Ship PAC (LSD)
31M2 Tank Landing Ship PAC (LST)
32A2 Destroyer Tender PAC (AD)
32C2 Ammunition Ship PAC (AE)
32G2 Combat Store Ship PAC (AFS)
32H2 Fast Combat Support Ship PAC (AOE)
32KK Miscellaneous Command Ship PAC (AGF)
32N2 Oiler PAC (AO)
32Q2 Replenishment Oiler PAC (AOR)
32S2 Repair Ship PAC (AR)
32X2 Salvage Ship PAC (ARS)
32GG2 Fleet Ocean Tug PAC (ATF)
32QQ2 Salvage and Rescue Ship PAC (ATS)
39E2 Amphibious Construction Battalion PAC
42T2 Tactical Air Control Group and Squadron PAC (VTC)
42KK Lamps MK III Fleet Introduction Team
C58B Surface Warfare Officers School Command Detachment
FB21 Amphibious Base PAC
FT43 Surface Warfare Officers School Command

Copy to: (COMNAVSURFPAC)

21A2 CINCPACFLT
22A2 Fleet Commander PAC
23A2 Naval Force Commander PAC (COMNAVFORJAPAN only)
24A2 Naval Air Force Commander PAC
24G2 Submarine Force Commander PAC
24H2 Fleet Training Command PAC
24J2 Fleet Marine Force Command PAC
28A2 Carrier Group PAC
29B2 Aircraft Carrier PAC (CV) (CVN)
FT35 Amphibious School (12)

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CHAPTER 1

INTRODUCTION

101. INTRODUCTION

a. For planning and execution of an amphibious operation, knowledge is required of surf and hydrographic conditions. Studies of both of these features must be conducted because the surf on a given beach depends not only upon beach exposure, but also upon the underwater topography. Furthermore the profile of sandy and gravel beaches are constantly altered by wave action.

b. Many of the craft employed on amphibious operations are relatively small and, because they must be designed to land upon or across the beach, are not truly sea-worthy in the traditional sense. These craft and amphibious vehicles must operate in the most treacherous regions of the ocean where reefs, sandbars and surf make boat handling hazardous even though man-made obstacles, enemy mines and gunfire are not encountered. The Surf Manual provides background on the formation of waves and swell and their characteristics as they break upon the beach as surf. There is an extensive description of surf, the surf zone and the effects of surf on landing craft.

c. The importance of accurate information on surf conditions to the performance of amphibious craft and vehicles and the safety of personnel has long been recognized. A significant portion of this instruction concerns the taking of surf observations (SUROBS) and their evaluation and provides the commander with an objective method of evaluating existing and forecast surf conditions with respect to the capabilities of the various landing craft to negotiate certain surf conditions.

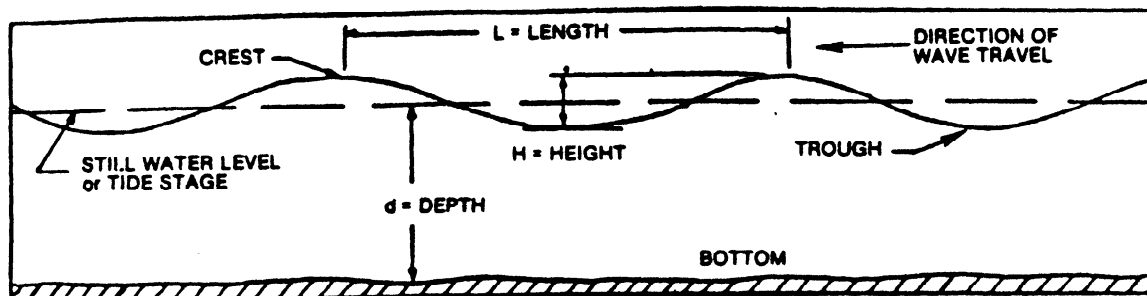
CHAPTER 2

GLOSSARY

201. GLOSSARY. This chapter provides a set of definitions and figures designed to provide the reader with a working vocabulary for discussion of the generation of deep water waves, their propagation to the shore, the surf zone, breakers, and the beach.

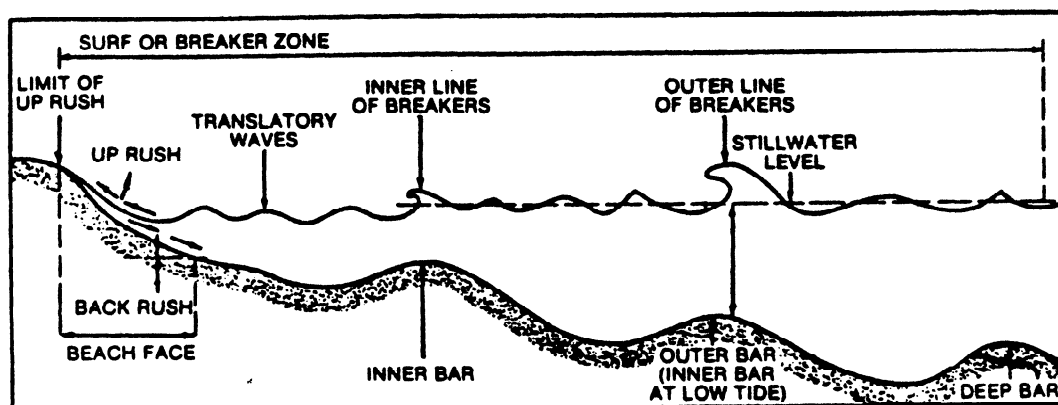
BAR:	A submerged or emerged embankment of sand, gravel, or mud built on the sea floor in shallow water by waves and currents. A bar may also be composed of mollusk shells. When it is a ridge generally parallel to shore and submerged by high tides, it is a longshore bar. Offshore bars or barrier bars or beaches are built principally by wave action on sand or gravel at a distance from shore and separated from it by a lagoon. When a bar extends partly or completely across the entrance to a bay it is called a baymouth bar. A crescentic bar commonly found off the entrance to a harbor is a lunate bar.
BERM:	The nearly horizontal portion of a beach or backshore having an abrupt fall and formed by deposition of material by wave action, and marks the limit of ordinary high tides.
BREAKER:	A wave tripped by shoaling water. The three types of breakers are spilling, plunging, and surging.
BREAKER ANGLE:	The angle a breaker makes with the beach.
DECAY DISTANCE:	The distance through which ocean waves travel as swell after leaving the generating area. In the process of decay the significant wave height decreases and the significant wavelength increases.
DEEP WATER:	Where water depth is greater than one-half the wave length. Deep water conditions are said to exist when the surface waves are not affected by bottom topography.
FETCH:	The area over which ocean waves are generated by a wind having a constant direction and speed. Also known as the generating area.
GRADIENT:	The rate of inclination to horizontal expressed as a ratio such as 1:25 indicating a one unit rise to 25 units of horizontal distance.
LITTORAL CURRENT:	Current moving generally parallel to and adjacent to the shoreline.
REFRACTION:	The deflection of a wave moving in shallow water at an angle to the depth contours, which causes the advancing wave to bend toward alignment with the depth contours.
SCARP:	An almost perpendicular slope caused by wave action and erosion along the shoreline.
SEA:	Waves generated or sustained by winds within their fetch; opposed to swell.
SECONDARY WAVE/ BREAKER SYSTEM:	A series of waves superimposed upon another series differing in height, period or angle of approach to the beach.

SHALLOW WATER:	Water of depths less than one-half the surface wave length; water of such depth that surface waves are noticeably affected by bottom topography.
SIGNIFICANT BREAKER HEIGHT:	The average height of the one-third highest waves of a given wave group.
STAFF OCEANOGRAPHER:	Any Oceanographer (180x), Limited Duty Officer (Meteorology 646x), Warrant Officer (Aerographer 746x), Aerographer's Mate forecaster (NEC 7412), or Geophysics subspecialist (appropriate P-code); trained in sea, swell, and surf forecasting; who is assigned to the staff.
SURFCST:	A forecast of surf conditions. (See Chapter 10)
SURF ZONE:	The area between outermost breaker and the limit of wave uprush.
SUROB:	An observation of surf conditions disseminated in a certain format. (See Chapter 10)
SWASH:	The rush of water up onto the beach following the breaking of a wave. Also known as uprush.
SWELL:	Ocean waves which have traveled out of their fetch. Swell characteristically exhibits a more regular and longer period and has flatter crests than waves within their fetch.
WAVE CREST:	The highest part of a wave.
WAVE HEIGHT:	The vertical distance between a wave trough and a wave crest.
WAVELENGTH:	The horizontal distance between successive wave crests measured perpendicular to the wave crests.
WAVE PERIOD:	The time required for a wave crest to traverse a distance equal to one wavelength.
WAVE STEEPNESS:	The ratio of wave height to wave length.
WAVE TROUGH:	The lowest part of a wave between successive wave crests.
WAVE VELOCITY:	The speed at which a wave form advances, usually expressed in knots.
WIND WAVE:	A wave resulting from the action of wind on a water surface. While the wind is acting on it, it is a sea, thereafter, a swell.



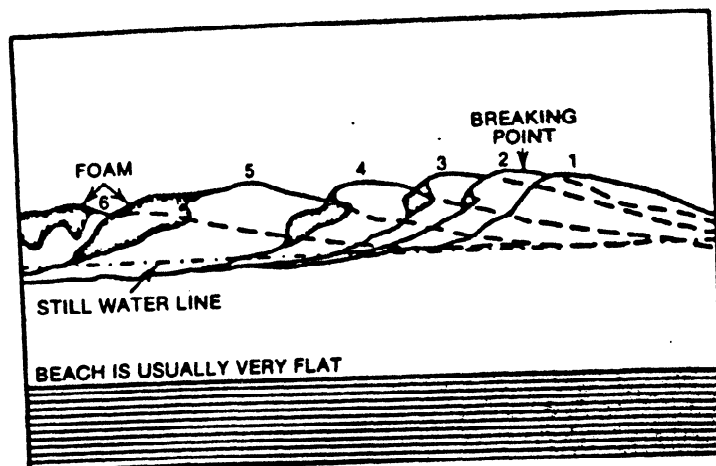
DEFINITIONS OF WAVE CHARACTERISTICS

FIGURE 2-1

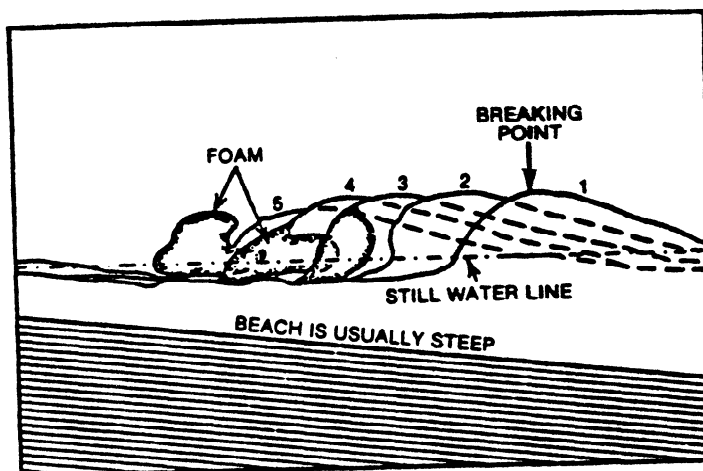


SCHEMATIC DIAGRAM OF WAVES IN THE BREAKER ZONE

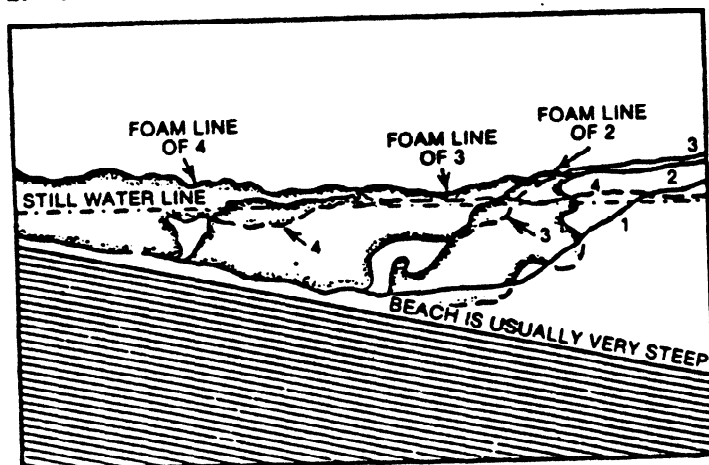
FIGURE 2-2



a. GENERAL CHARACTER OF SPILLING BREAKERS

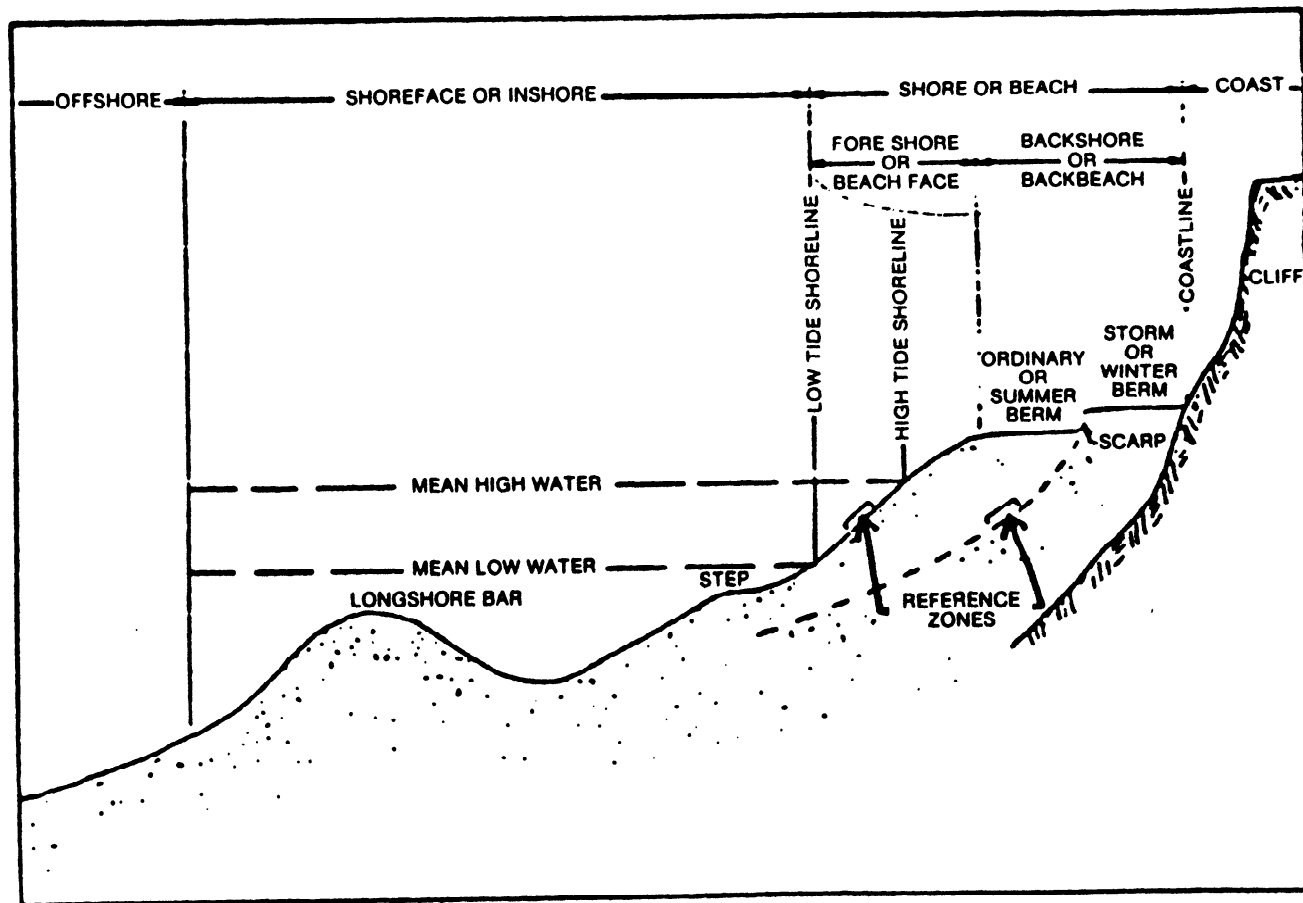


b. GENERAL CHARACTER OF PLUNGING BREAKERS



c. GENERAL CHARACTER OF SURGING BREAKERS

FIGURE 2-3



SHORE PROFILE ILLUSTRATING TERMINOLOGY

FIGURE 2-4

CHAPTER 3

SEA AND SWELL

301. WAVES. Since there is considerable variation in wave height and wave length in the waves leaving a generating area, it is necessary to define statistically the significance of the waves. Actually the higher waves are the more important from an operations standpoint; hence in stating the mean height of the waves that exist over a period of an hour or two it is advisable to consider only the highest of the waves that are present. Obviously, every ripple need not enter into forming an average. As a consequence of these considerations the present practice in stating the average wave height is to give the average height of the highest one-third of all observed waves. Where the observation is precise, as in analyzing the records of wave recorders, the average of the highest one-third of the major train of waves is used. This average is called the SIGNIFICANT WAVE HEIGHT.

. SEA AND SWELL

a. There are two types of wind waves, sea and swell. Sea is the type of wind wave found in a storm area or fetch where the waves are being generated. These waves are usually steep and have a short period. Frequently the crests break in deep water. When small, these are called whitecaps. When large, they are called combers or breaking seas. In deep water such waves affect the performance of small craft and interfere seriously with navigation of small boats. As these waves leave the fetch they begin to decay. The significant wave height decreases while the significant wavelength increases. The waves outside the fetch are known as swell and are characterized by a long, smooth undulation of the sea surface. Swell can travel great distances to break on a shore thousands of miles from the generating storm. Such waves never break in deep water and unless very high do not affect the operation of small craft in deep water except that they may impose heavy stress on gear which is being operated over the side. They do, of course, cause rolling and pitching of large vessels. Swell is most important in that upon reaching shallow water the wave height increases greatly, giving rise to an immense surf which may cause damage or destruction to shore installations and make the entrance to harbors impassable.

b. Sea and swell usually exist simultaneously at any time in open water. Swell may be completely obscured by the sea generated by the local winds and it may be only near shore, when the swell has peaked up to a great height, that the operator of a small craft is aware of the presence of such a swell. To reiterate, it is the swell which ordinarily makes harbors and river entrances impassable to ocean traffic and the surf zone impassable to landing craft. This swell arising from distant storms approaches the coast at high speeds and in the case of a large offshore disturbance the swell will ordinarily arrive prior to the disturbance, thus ships attempting to reach harbors ahead of a storm may find that the entrance is impassable because of the breaking swell.

303. DETERMINATION OF SWELL FROM WEATHER MAPS. For a locality on an exposed coast, where critical wave conditions result from swell which is generated by storms occurring at considerable distance from the coast, local wind records are of relatively small value in the compilation of significant wave characteristics. Thus where large scale wind patterns are involved there are seldom sufficient weather reports to determine these patterns directly from ship or island observations. There is a very close relationship between the wind speed and direction and the atmospheric pressure gradient which can be determined from a weather map. The pressure field is not difficult to determine if sufficient surface weather reports are available. The winds, therefore, are computed from the pressure gradient scaled from a weather map, and wind observations are used to check the computed values. A consideration of the orientation of the isobars on a weather map also permits an estimate to be made of the extent of the generation area and, the value of the fetch, and the direction of wave propagation.

304. SOME BASIC CONSIDERATIONS OF THE WAVE MECHANISM

a. The essentials of energy input into the wave mechanism are the velocity of the wind, its duration and the fetch. The wind direction determines the locality of eventual wave attack. The important characteristic of the transporting mechanism is the distance of decay. The nature of their attack depends upon their

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direction, period and upon the shoreline configuration. The degree of attack and overall rate of energy output is a function of their height and period.

b. In general, the longer the fetch, the higher will be the waves and the greater their period, length, and velocity. For a particular fetch and wind velocity there is a maximum wave height and period that can be developed regardless of the duration of the wind. In a generating area the waves are steep and short crested with many of them breaking as whitecaps. After leaving a generating area the wave length, period and velocity gradually increase. The shorter waves possess relatively little energy and soon disappear, but the longer waves become more regular the farther they travel and, in the case of some ocean waves, may travel thousands of miles from the generating area before breaking on a distant shore.

c. There have been many times when waves generated at a distance of over 3,500 miles have reached a coast with sufficient size to give breakers up to about 10 feet in height. On the Southern California coast waves from storms in the southern hemisphere, almost 5,000 miles away, have been observed on numerous occasions.

CHAPTER 4

BREAKERS

401. BREAKER TYPES

a. Perhaps the most important difference between breakers of similar height is the overall manner in which the breaking takes place; that is, whether the breakers are spilling, plunging, surging, or an intermediate type. Breaker type is related to the deep water wave height, wave period, and beach slope as seen in Figures 2-3 and 4-1.

b. Spilling Breakers. In a spilling breaker the energy which the wave has transported across many miles of sea is released gradually over a considerable length of time and over a considerable length of the breaker in its travel towards the beach. The spilling breaker is characterized by a breaking process wherein the wave peaks up until it is very steep but not vertical. Only the topmost portion of the wave curls over and descends on the forward slope of the advancing wave where it then slides down into the trough. This process starts at scattered foci which coalesce until the wave becomes an advancing line of foam. An example of a spilling breaker can be seen in Figure 4-2.

c. Plunging Breakers. In a plunging breaker the energy is released suddenly into a downwardly directed mass of water and is dissipated into heat by turbulence. In the plunging type, the wave peaks up until it is an advancing vertical wall of water. The crest then curls far over and descends violently into the preceding trough where the water surface is essentially horizontal. A considerable amount of air is trapped in this process and this air escapes explosively behind the wave, throwing water high above the surface. The plunging breaker is characterized by a loud explosive sound and the character of the surf can be ascertained when it is not visible for reasons of fog or darkness. Plunging breakers are far more common on the west coast of North America and the Pacific Ocean, in general, than they are in the Atlantic Ocean and Mediterranean Sea. An example of a plunging breaker can be seen in Figure 4-3.

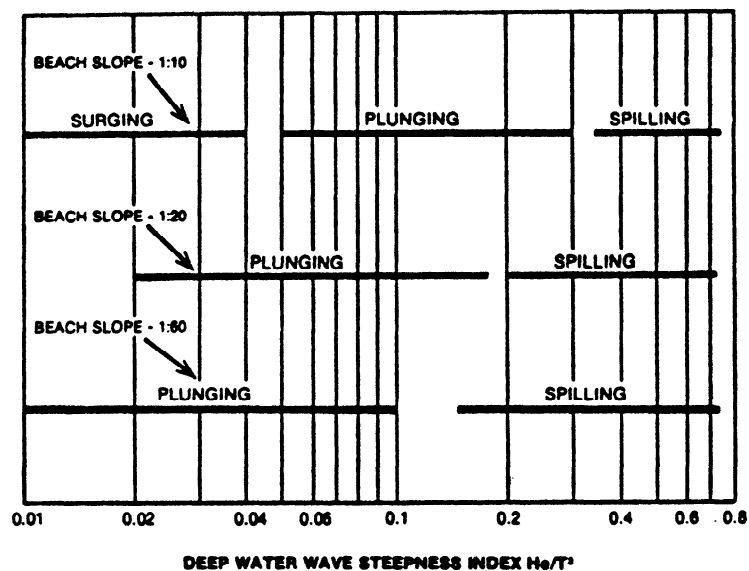
d. Surging Breakers. Another type of breaker which is less frequently observed is the surging breaker. In this case the wave crest tends to advance faster than the base of the wave to suggest the formation of a plunging breaker. However, the wave then advances faster than the crest, the plunging is arrested, and the breaker surges up the beach face as a wall of water which may or may not be white water.

402. CAUSES OF DIFFERENT BREAKER TYPES

a. As ocean swells or waves approach the shore they peak up to a greater height. The wave length becomes shorter and the crest becomes narrower and higher. The longer and lower a wave is, the more it will peak up as it advances into regions of shoal water. Thus storm waves which have a relatively short wave length and great height do not peak up to a much greater height prior to breaking. It must be realized that this is an ideal presentation of the relationship and does not consider such influencing factors as refraction, offshore bars, etc. During the process of peaking up, as the waves enter shoal water, they become progressively less stable. When a wave plunges the ultimate condition of instability has been reached simultaneously by a considerable length of crest and thus a great length of the wave crest curls over and descends in the manner previously described. If during its entry into shoal water a wave is subjected to disturbing influences, certain small portions of the crest become unstable prior to the time that the entire length of the crest has reached a similar condition. These small parts then may start to break but are impeded by the effect of adjacent regions which have not yet become unstable. The breaking then is of a spilling nature in which only short parts of the wave crest break and the general effect is a much less violent process. The disturbing influences which may result in spilling breakers are superimposed short period wind chop arising from local winds, reflected waves from nearby rocks, or bottom irregularities.

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**GRAPH SHOWING RELATIONSHIP OF DEEPWATER
WAVE STEEPNESS TO BEACH SLOPE IN THE
FORMATION OF DIFFERENT WAVE BREAKER TYPES**

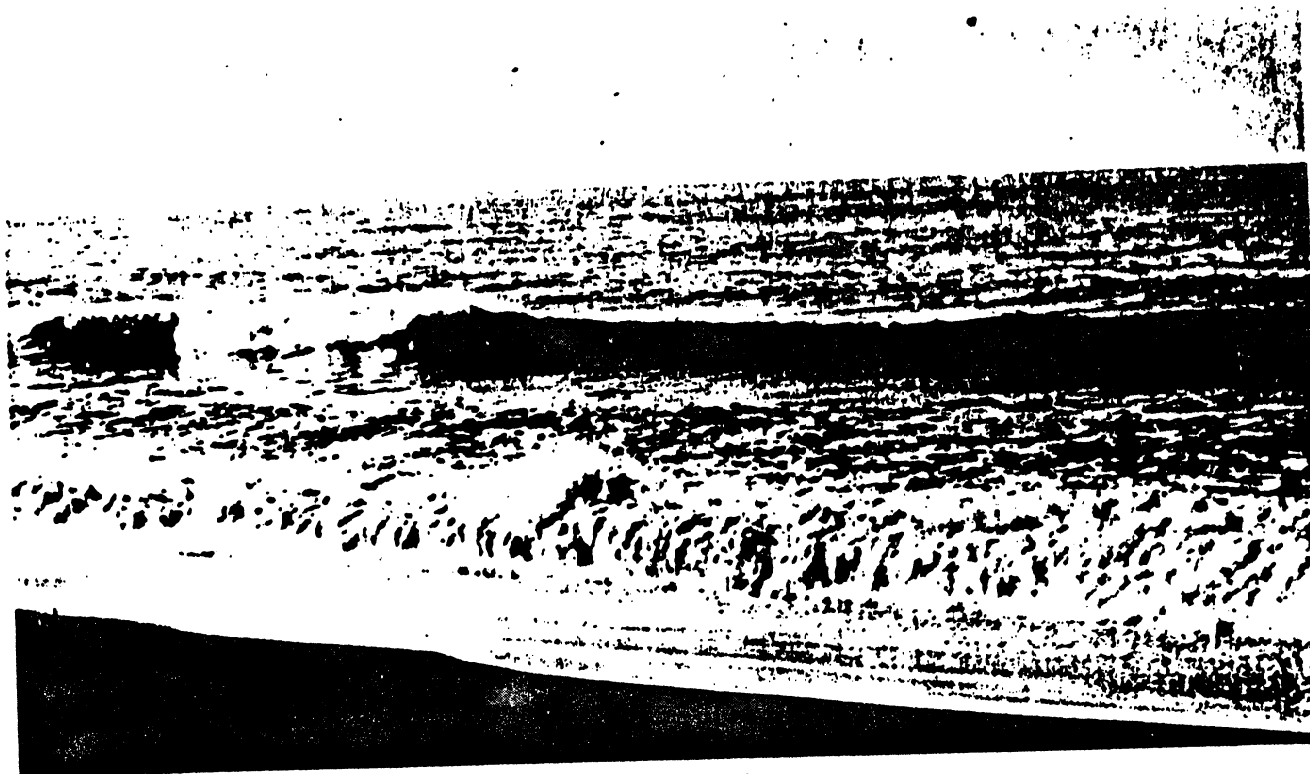


Deepwater wave steepness $\frac{H_0}{T^2}$ $\frac{\text{Wave height in deepwater}}{\text{Wave period in deepwater (squared)}}$

EXAMPLE: If the deepwater wave height is 4.0 feet, deepwater period 10 seconds, and the beach slope 1:20, dividing the period squared into the height will give a Deepwater Wave Steepness Index of .04, entering the graph with .04 and the beach slope of 1:20, the breakers will be of the plunging type.

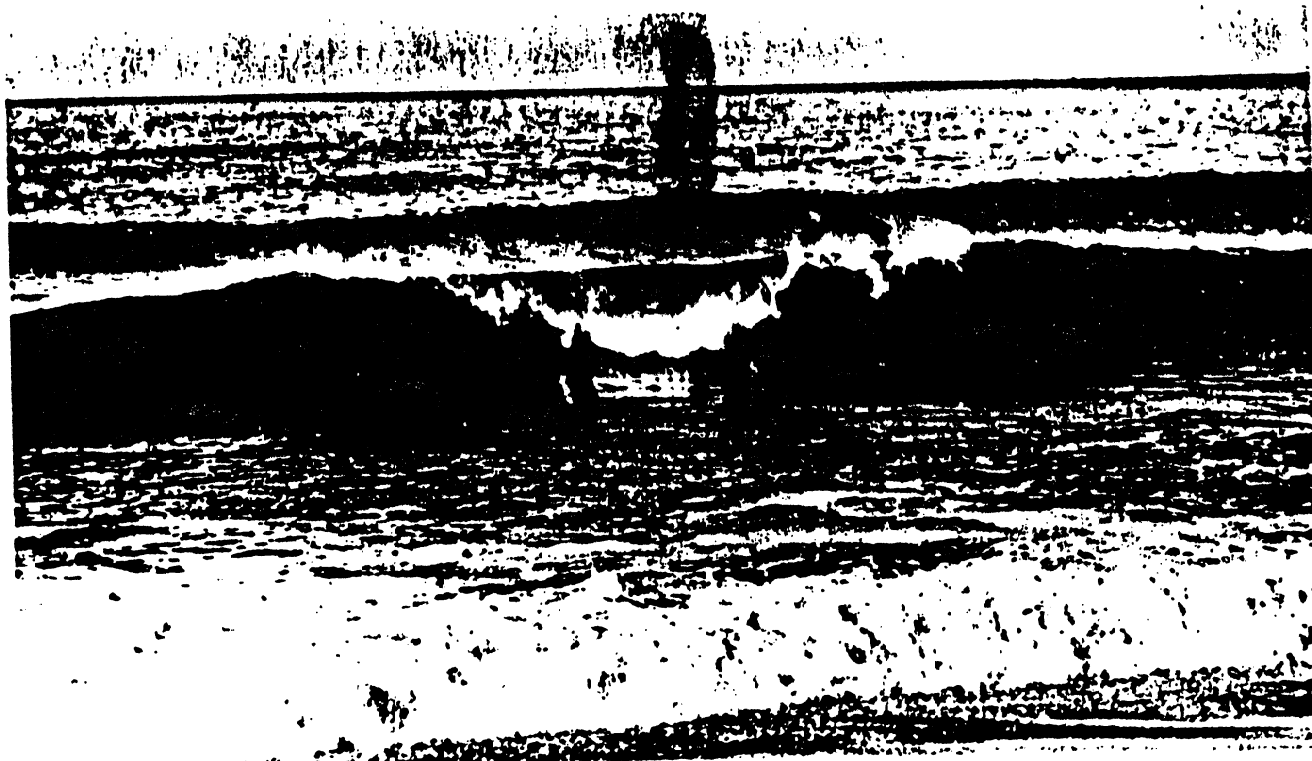
FIGURE 4-1

ILLUSTRATIONS OF VARIOUS SURF CONDITIONS



Spilling breaker

FIGURE 4-2



Plunging breaker

FIGURE 4-3

b. Storm waves are not only inherently more likely to spill when they reach shore, but are also more likely to be disturbed because of the presence of short choppy waves existing in this disturbed region. Long swell on the other hand frequently will reach the coast during calm windless weather. Long swell is inherently inclined to produce plunging breakers and also will be likely to do so because of the probable absence of disturbing wind waves at the time of their arrival. Winds blowing toward the sea destroy short period waves from local sources but permit the passage of long period swell. Thus when the wind is offshore, ideal conditions exist for the production of plunging breakers. In addition to this there seems to be an aerodynamic condition resulting from the waves causing them to plunge even more violently under this situation than they would if no offshore wind were present. The wave seems to pass the normal breaking point and peak up to a greater height before breaking when the wind is opposing.

c. Breakers are more likely to plunge or surge on steeper beaches. High backwash velocities promote the retardation of the base of the advancing wave to establish the plunging tendency. When the backwash depth becomes too small the retardation is not effective and the advancing wave tends to surge.

403. EFFECT OF BEACH PROFILE ON BREAKER TYPE. There is some greater tendency for plunging breakers to occur on the steeper beaches than on flat beaches. This seems to be due to the fact that as a wave advances upon a beach of steep gradient there is less time spent in attaining an unstable condition and consequently less opportunity for disturbing conditions to initiate a spilling process. In addition to this, flat beaches are frequently of an irregular profile and the bottom irregularities result in the production of spilling breakers at most points along such a beach. When plunging breakers occur upon beaches of flat profile it has been noted that this is associated with an unusually regular beach or the occurrence of a temporarily steep section of the beach profile in the breaker zone. In this connection beaches in partly protected bights, bays and estuaries which are subjected only to waves that have undergone considerable refraction or diffraction almost invariably produce plunging breakers. In this case the beach profile is normally very regular, disturbing influences are at a minimum, and the short period wind waves have been screened out. Although not practical for planning purposes, it is possible for a surf condition to be modified by the creation of a secondary disturbance when the surf is of a predominately plunging type. This might be accomplished by artificially generating a secondary disturbance and altering the breaker type. It has been noted in observing amphibious landings that a surf consisting primarily of plunging breakers was so altered by the bow waves of the landing craft which set up a modified region in the surf. A heavy plunging surf has sometimes become passable during the first two or three hours of a storm due to the alteration of breaker type by wind waves. As in other natural processes the energy required to "trigger" the releases of wave energy is small. The breaker height and the breaker type are most important surf factors in judging the feasibility of an amphibious operation on any beach. There are several other factors which enter into the condition of the surf as regards such an operation. Figures 2-3 and 4-1 show the relationship of breaker types with beach slope profiles.

404. EFFECT OF BREAKER ANGLE ON LANDING CRAFT. The angle at which the waves break in respect to the general shoreline contours imposes a number of complications to an amphibious operation. Long period waves reaching a beach of normal slope will undergo such refraction that there is rarely any appreciable angle apparent at the breaking point. Short period waves, wind waves and chop do not undergo any great change of direction in approaching a beach and if their deep water angle of approach is not normal to the beach they will break at an angle. Likewise long period waves reaching a beach in a region of very steep offshore slopes may not undergo sufficient refraction to eliminate the effects of direction upon the breaker angle. This condition is characterized by waves which strike the beach first at one end or the other and a breaking process which proceeds down the beach in the direction in which the waves are traveling. The effect of this obliquity is to set up a current in the surf zone traveling parallel to the shore and in the same direction as the waves are traveling. For high waves of great angle this littoral drift may be as great as three or four knots and impose great difficulties upon an amphibious operation. In addition, under these conditions, an amphibious craft traversing the surf zone is subject to wave impact at an angle with the normal line of travel. This combination very readily leads to broaching in the surf and for ordinary craft broaching while on the beach. The LARC and LVT are not critically affected when they are land-borne. Such longshore currents do

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produce a much more hazardous landing condition than exists in their absence. The currents have a much greater velocity in certain parts of the surf zone and the operator must be constantly alert to combat their effects and avoid broaching. In order to successfully traverse the surf zone where the waves are breaking at an angle it is necessary first to estimate the direction and total distance of drift and to direct the course so that the craft always meet the breakers normal to their crest; that is, head on or directly astern.

405. EFFECT OF BREAKER PERIOD ON LANDING CRAFT. The period of the breaker is a very important factor primarily as it frequently determines the type of breaker, the amount the wave will increase in height as it approaches breaking, the amount of refraction the wave undergoes and the velocity of the wave. These matters are described as separate factors and the direct effect of period on the amphibious operation is simply a matter of the rapidity at which the craft encounters breaking waves. Short period storm waves from local sources may arrive every six to twelve seconds. The landing craft does not have an opportunity to pass the breaking point without meeting a breaking wave, and is subjected to such a continuous impact that the coxswain may lose his bearings and be unable to orient himself. Long period waves may arrive every ten to twenty seconds and on steep beaches there is an opportunity for the landing craft to pass through the breaker zone between waves.

406. EFFECT OF BOTTOM CONFIGURATION ON BREAKERS. In general, at any point on a beach where the breakers are occurring farthest from shore the breaker will be highest. This results from the fact that offshore from such a point there must be a bottom configuration tantamount to a submarine ridge. Such configuration leads to the convergence of waves upon the portion of the beach immediately to shoreward thereof. Conversely, regions in the surf zone where the outer breakers are constantly breaking closer to shore than elsewhere will be generally regions of lower breakers due to the fact that here a condition of divergence over a small channel must exist. The presence of rip currents in such channels complicates the refraction pattern in such regions and there are normally present two opposing situations; first the currents which tend to make the waves converge and the partial channel which tends to make the waves diverge. If the first condition governs, the waves may completely converge and break in the middle of the channel. They will almost invariably be breakers of a spilling nature and consequently less hazardous than the waves which would be encountered on the more seaward points.

407. ESTIMATING THE HEIGHT OF BREAKERS. As a deep water wave approaches a beach it begins to peak up as it "feels bottom" and continues to increase in height until it breaks. Thus it is never safe to estimate the height of a wave offshore and assume the breaker height will be the same. Breakers are usually larger than they appear from the beach. A method of estimating the height of breakers visually and without mechanical or optical aids is as follows: The observer on the beach adjusts his position vertically so that his line of sight corresponds with an imaginary line from the top of a breaker to the horizon. The vertical distance from this line to the lower limit of the backwash will be the approximate height of the breaker. The lower limit of the backwash in this case being considered the lower limit of the trough between breakers close to the beach. This system is progressively less accurate as distance increases. (See Figure 4-4)

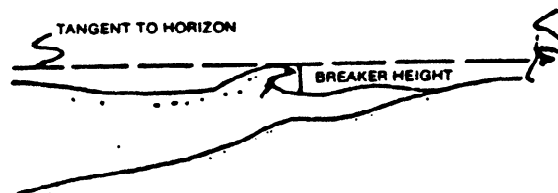


FIGURE 4-4

408. VARIABILITY OF BREAKER CHARACTERISTICS. Breaker characteristics vary considerably both with respect to time and location. The degree of variability is often quite difficult to ascertain. To the casual observer a sequence of waves often appears to have regular characteristics. That this is not true would be proven by a numerical tabulation of successive individual waves. Surf characteristics are just as irregular as the ocean bottom topography over which the swell must travel as it advances toward the beach. In any wave system an exceptionally high wave can develop. These outsized waves, though improbable, are possible and the exact time of occurrence or location of such wave can never be predicted. Because of breaker variations, surf observers should record a sample of at least 100 breakers in order to obtain representative values. A sample of 50 breaker heights is acceptable under actual combat conditions. Commands responsible for detailing surf observers should consider these factors and allow adequate time for accurate observations.

409. DEPTH OF BREAKING. The depth of breaking is the still water depth at the point where the waves break. The depth of breaking on an evenly sloping beach is approximately 1.3 times the height of breaking. However, when a bar is present it may cause waves to break in water up to 1.7 times the breaker height.

410. SPEED OF BREAKERS. The speed of a breaker depends upon the depth of breaking. For a six foot breaker the depth of breaking is eight feet and it follows that this breaker advances with a speed of about ten knots. The relationship of breaker height to breaker speed of advance is shown in the following table.

<u>BREAKER HEIGHT</u>	<u>SPEED OF BREAKER ADVANCE</u>
4 Feet.....	8.5 Knots
6 Feet.....	9.8 Knots
8 Feet.....	11.0 Knots
10 Feet.....	12.2 Knots
12 Feet.....	13.3 Knots

CHAPTER 5

THE SURF ZONE

501. THE SURF ZONE. Although the character of the surf zone is primarily dependent on the height, type, angle, and period of the breakers in the surf zone, several other factors affecting the surf zone will impact on amphibious operations. This would include multiple wave fields, surf beat, sandbars, beach slope, tide, refraction, and littoral currents.

502. SURF

a. As with wind waves, the surf may be divided into two categories; that caused by waves from local onshore winds and that caused by swell from a distant generating area or fetch. A combination of these two may be found together, causing the surf zone to assume a mixed and irregular character.

b. The surf caused by local wind waves is characterized by shore irregular crest, spilling breakers, and a generally confused aspect. The waves offshore are steep with many white caps and the crests do not increase in height before they break. The wave period is short, usually about five or six seconds. Surf of this category is a characteristic of the continental coasts outside the tropics and of all confined waters. It was the only surf of importance on the Normandy beachheads, since swell from the open ocean does not enter the English Channel in summer.

c. The surf zone caused by swell from a distant wind area is characterized by regular crests, plunging breakers and long lines of foam. The period of the breakers range from eight to fifteen seconds and the crest length at breaking is usually greater than one hundred and fifty feet. The waves offshore appear low and rounded, but immediately before they break they peak up sharply, in some cases even doubling their deep-water height. In the northern hemisphere surf zones caused by swell only is a characteristic of western continental shores south of 35 North, which are exposed to swell from the prevailing northwesterly winds in the middle latitudes. North of 35 North the western coasts are exposed to both sea and swell, and a mixed surf zone is usually encountered. Surf zones caused by swell occur on the north and east coasts of the Philippines and the east coast of Taiwan during the seasons of the northeast monsoon and the typhoons. Typhoons may also give rise to surf caused by swell on the coast of China and Japan and around western Pacific islands.

503. EFFECT OF SURF BEAT ON LANDING CRAFT. Surf beat is the long wave oscillation of the mean water level within the surf zone. As observed from the beach, it can be seen as a distinct rise and fall of the water level. Surf beat can be of significance to landing craft approaching submerged obstacles such as reefs and bars. As a rule, the surf beat is proportional to the breaker height, and is normally equal to ten percent (10%) of the breaker height.

504. SANDBARS

a. Wherever bars are present the wave crests will peak up as the waves roll over the bar. The water depth over the bar and the wave height determine whether or not breaking takes place on or near the bar. If the water depth over the bar is more than twice the significant breaker height, nearly all waves will pass over the bar without breaking but the crests will peak up distinctly. If the depth is between one and two times the breaker height, waves will break near the bar, some on the bar itself and others on the shoreward side. With water depth less than the breaker height all waves will break on the seaward side. Frequently more than one bar exists with waves breaking and reforming, and breaking again on another bar or on the beaches. The striking pattern of these breakers in aerial photographs is a certain indication of the presence of bars. Off Vierville-Surmer, Normandy, several bars exist. Shallow bars can seriously impede landing craft. (Sicily).

b. Various types of bars are found off shorelines. The type of bar related to coral islands will not be considered here since this type is now of less significance to landing operations and also has been well described elsewhere. Of the submerged sand bars, three common types exist. The first type is found off many large rivers and is often associated with deltas. The multiple bars of this

type cover a large area and have a wide range in depth, many of them extending above sea level. Charts of these bars are accurate only at the time they are made. The bars change tremendously in size and position at times of floods and high surf. The general effect of floods is to decrease their depth and to increase their area whereas high surf has the opposite effect.

c. The second type of bar has roughly a crescent shape and extends convexly out from the mouths of rivers and from the bottleneck entrance of bays. Well known examples are found off San Francisco Bay, the Columbia River, and Humboldt Bay. The bars off these areas are too deep to interfere with landing craft, but many such bars off smaller entrances are sufficiently shallow to offer serious hindrance to landings. In landing operations it may be of advantage to use beaches in estuaries and bays where the surf is low, but access to these areas may be difficult because of high breakers on the deep crescentic bar lying off the estuary or bay. Ordinarily there is at least one channel through the bar. While the position of the channel may shift it is likely to remain at the same general location and can be spotted from the air. This type of bar probably deepens during periods of high surf, although no direct evidence is available.

d. The third type comprises bars which parallel the majority of sand beaches. In some places they occur only during the season of largest waves, but elsewhere they persist throughout the year. Longitudinally the bars may be continuous for miles, but are likely to be discontinuous, being developed off some portions of a beach and not off others. The breaks in the bars can be detected from the air from the breaker pattern. In some very sandy areas a series of bars extends for miles out to sea and the outer ones attain depths far too great to interfere with amphibious operations. However, the typical depth of the longshore bars ranges from about 3 to 15 feet below mean low water.

e. These offshore bars, particularly the shallower ones, are a serious menace to landings. Landing craft are often "hung" on the crest of the bars and a considerable time interval may elapse before they are able to cross. If troops debark while the craft is hung on the bar, they must cross a channel between the bar and the beach. This channel may be too deep to cross by wading and may have strong currents. Where large waves are approaching the crest diagonally these currents are especially prominent. In some cases where a landing craft is hung on the bar the current will cause it to broach.

f. Bars are greatly modified in depth and distance from shore by high surf. From available data there appears to be a rough relationship between bar depth and the maximum breaker height during the preceding one or two weeks. It seems likely that the bar would attain a depth slightly less than the depth of breaking at low tide, if the breakers remained constant in height for a sufficient period. However, the large waves do not ordinarily last long enough to bring about this adjustment. Daily measurements of variation of bar depth with wave height were made along a California pier. It was found that high breakers caused rapid deepening of the bar. Also the high breakers often decreased the size of the bars or even eliminated them, but in some other cases high breakers caused the formation of a bar by cutting inside the most violent breaker action and leaving a somewhat higher zone outside. With low breakers the bars tend to grow shallower and to move shoreward. The trough inside the bar either keeps pace or fills more rapidly until the bar disappears.

g. There is reason to believe that the troughs inside the bars may be filled quite rapidly if the usual longshore current is reversed. Since this current in areas lacking strong longshore currents is determined largely by the direction of the approach of the swell, change in the current direction may be detected by aerial photographs. In the areas with longshore tidal currents the bars are likely to exist at all seasons.

h. The bars along the California coast show a marked seasonal effect. They are practically non-existent at the end of the summer period of small swell. In general, in the fall they form during or shortly after the first period of high breakers. During the winter the bars deepen and as the breakers decrease during the spring the bars move shoreward and decrease in depth, being largely eliminated during the light surf period of the summer. While only fragmentary evidence is available from other areas it seems very probable that the same sequence develops in relation to the stormy season.

505. BEACH SLOPE

a. The importance of beach slope to surf lies in its effect on the width of the surf zone. The breaker line which represents the seaward border of the surf zone is found where the depth to the bottom equals about 1.3 times the significant breaker height. Thus, with 6-foot breakers the breaker line is located where the depth to the bottom is about 8 feet, regardless of beach slope. Off a beach with a slope of 1:10 the breaker line for six foot breakers is only about 80 feet from the shore line, whereas off a beach with a slope of 1:50 the breaker line is about 400 feet from the shore line.

b. Off a very steep beach there may be no lines of foam inside the breaker line, and each wave, after breaking, rushes violently up the shore face and hits any beached craft with great force. Off a flat beach on the other hand, there will be numerous lines of advancing foam between the breaker line and the shore line, the energy of the waves will be expended during the advance through the surf zone and there will be only a gentle uprush and backrush on the beach.

506. TIDE. The stage of the tide has little effect on the height of the breakers but can have a profound effect on the width and character of the surf zone. This is the case on beaches with bars and on beaches which have a steep upper slope with a very gentle slope at or below the low-water line. These effects of the tide are illustrated schematically in Figure 5-1. Figure 5-1a shows a beach which at high tide has the characteristics of a steep beach with 6 foot breakers at a distance of 80 feet from the waterline, but at low tide has the characteristic of a flat beach with 6 foot breakers at a distance of 250 feet from the waterline and with several lines of foam in the surf zone. Figure 5-1b shows a flat beach with an off-lying shallow bar which is nearly exposed at low water. At high tide there is a single line of breakers but at low tide the waves break beyond the bar, reform and break again on the beach.

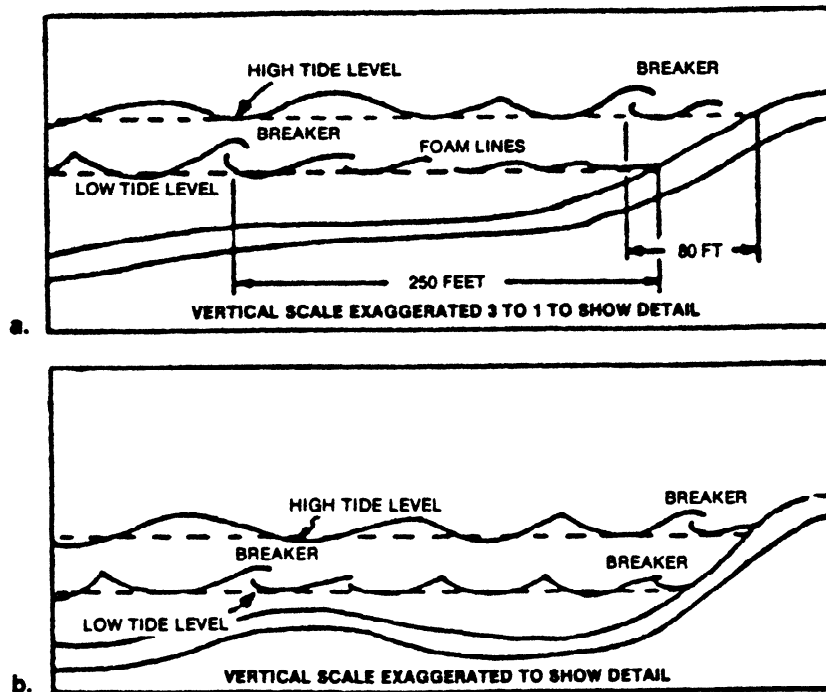


FIGURE 5-1

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507. REFRACTION

a. The surf depends not only upon the beach slope directly off the shore line but also upon the bottom contours at great distances from the coast. As soon as a wave travels into water which is sufficiently shallow for the wave to "feel bottom" its speed decreases. Therefore, when a wave approaches a straight coast at an angle the part of the wave first reaching shallow water slows down, whereas the part which is still in deep water speeds on, with the result that the slowing wave crest swings around and tends to become parallel to the coast line. This bending of the crests is called REFRACTION. Refraction accounts for the fact that the breakers nearly parallel the beach even when the offshore waves travel at a considerable angle with the coast line.

b. Refraction also occurs where waves travel over an irregular bottom. The portion of a wave over a submarine ridge is slowed down, and the portions of either side tend to swing in toward the ridge. Where the waves swing together, each crest is squeezed and the wave height is increased. Heavy surf is found wherever a submarine ridge runs out from a coast. A submarine canyon has the opposite effect. The portion of the wave over the canyon travels faster than that on either side, and tends to fan out. Where the wave fans out, the crest is stretched and the wave height is decreased. The surf is light wherever a submarine canyon runs out from the coast. This relationship observed by navigators has given rise to the expression "the point draws the waves" as they realized that the waves are frequently higher offshore of a point. Similarly seamen also have learned that the sea may be calmer at the head of a submarine canyon than in the regions on either side.

c. Refraction also causes the waves to swing in behind islands and peninsulas where they could not reach if they continued in their original direction. Therefore, the amount of protection afforded by headlands, peninsulas, islands, and other obstructions depends as much upon the underwater topography as upon the shape of the coast line.

d. In order to predict the variation in surf along the coastline, refraction diagrams must be prepared. They must be based on the most accurate charts of the region and must be constructed for waves of different directions and periods. Since the relation between wave speed and depth is known, it is possible to plot the advance of a wave during given time intervals. Such diagrams show the pattern of the wave crests as they approach the shore and reveal the regions where the crests are "squeezed" or "stretched". From this pattern, it is possible to calculate the variations in breaker heights along the coast.

508. SECONDARY WAVE SYSTEM. Two series of swell approaching a beach from different angles can cause a confused or dangerous surf condition. One series superimposed upon the other will differ in one or all respects as to height, period and angle to the beach. This will reinforce the heights or create a hazardous surf condition with an extremely complex current. The heights, period and angle to the beach made by a secondary system must be reported in the remarks section (HOTEL) of the SUROB.

CHAPTER 6

CURRENTS

601. OFFSHORE CURRENTS

a. Both offshore and inshore currents are of importance in amphibious operations. Offshore currents--tidal or nontidal--are found outside the surf zone. Tidal currents predominate around the entrances to bays and sounds and in channels between islands, or between an island and the mainland. They are oscillatory, that is they change their direction every six or 12 hours, depending upon whether there is a semidiurnal or a diurnal tide, and in narrow sounds they may reach velocities of several knots. On the surface tidal currents may be visible as "tide rips", areas of broken water and white caps. The tidal currents are predictable, if sufficient observations have been made, because they repeat themselves as regularly as the tides to which they are related.

b. Nontidal currents are related to the distribution of density in the ocean and the effect of the winds. Examples are the Gulf Stream off the American east coast and the Kuroshio which flows along the east coast of Formosa, west of the Ryukyus, and along the southeast coast of Japan to latitude 35° N. In the Kuroshio, velocities up to three knots have been observed. Currents of this type are constant for long periods, although they may vary in velocity and direction at different seasons of the year.

602. SHORE CURRENTS. Shore currents are set up within the surf zone by the breaking waves. Longshore or littoral currents flow parallel to the shoreline inside the breakers and are most commonly found along straight beaches. They are caused by waves breaking at an angle with the beach. Their velocity increases with increasing breaker height, with increasing angle of the breaker with the beach, and with steeper beach slopes. (Note: A breaker arriving parallel to the beach has an angle of 0° to the beach.) It decreases with increasing wave period. With 8 foot breakers sustained velocities of three knots have been measured. The longshore currents are predictable but the accuracy of the forecast will depend upon the accuracy of the wave forecast on which it is based. In areas where longshore currents are common, sand bars are usually present.

603. RIP CURRENTS

a. Rip currents flow out from shore through the breaker line in narrow rips and are found on almost all open coasts. They consist of three parts, the "feeder currents" which flow parallel to shore inside the breakers, the "neck" where the feeder currents converge and flow through the breakers in a narrow band or "rip" and the "head" where the current widens and slackens outside the breaker line. An observer can distinguish the neck of a rip current as a stretch of unbroken water in the breaker line. The outer line of the current in the head is usually marked by patches of foam and broken water similar to tide rips, and the head itself is usually discolored by the silt in suspension.

b. Rip currents are caused by the waves piling water against the coast. This water flows along shore until it is deflected seaward by bottom irregularities, or until it meets another current and flows out through the breakers. Once feeder and rip currents have formed, they cut troughs in the sand and remain fairly constant in position until the wave conditions change. Common locations are at the heads of indentations in the coast. When waves break at an angle on an irregular coast, the rips will be found opposite small headlands which deflect the currents seaward. In this case there is only one feeder current. The velocity of the feeder and rip currents, up to two knots, and the troughs they cut in the sand may both form hazards for landing craft.

c. Any time that waves break at an angle with the beach, currents will be formed in the surf zone. If the beach is straight they will flow along the beach as longshore currents, and if the beach is irregular they will flow along the shore for a short distance and then flow out to sea as rips.

CHAPTER 7

LANDING CRAFT CASUALTIES

701. TYPES AND CAUSES OF LANDING CRAFT CASUALTIES

a. A casualty is defined as any mishap by which a craft is put out of operation temporarily or permanently. Casualties due to beach and surf features can be summarized as follows:

- (1) SWAMPING by breakers when approaching or retracting;
- (2) HANGING up on a bar;
- (3) BROACHING on a bar or on the beach;
- (4) PLOW-IN or collapse of the forward skirt of LCAC due to steep beach gradient or large breaker height.

b. The surf and beach conditions to which such casualties may be ascribed, even with expert boat handling are:

- (1) The character of breakers, their height, type, and period;
- (2) Presence of bars;
- (3) The beach slope which, with a given breaker height, determines the width of the surf zone;
- (4) Longshore currents

702. SWAMPING OF LANDING CRAFT

a. Swamping is rarely caused by surf conditions alone. Even with 10 to 12-foot breakers, an experienced coxswain can bring his craft safely through the breaker line, but he has to use all his skill because these breakers travel with a greater speed than his craft. The speed of a 10-foot breaker is 12 knots and the top speed of an LCVP or an LCM is about 10 knots. If a craft is overtaken by a plunging breaker, it will be in great danger of being swamped. If it is overtaken by a spilling breaker, it may "surf board", that is, it may be carried along by the foaming water, get out of control and collide with another craft. If there is a narrow surf zone, the coxswain may not regain control before the craft hits the beach and broaches.

b. During the retraction, there is a greater danger of the craft being swamped, particularly if it ships water from several successive breakers. Retraction through plunging breakers is more difficult than through spilling breakers, but that is partly compensated for by the longer periods of plunging breakers. An experienced coxswain can generally retract an LCM safely through about 7-foot breakers.

703. HANGING AND BROACHING OF LANDING CRAFT

a. Most casualties occur because craft get hung on a bar or broach on a bar or on a beach. With the same depth of water over a bar, the risk of getting hung is greater when the breakers are low, because higher surf may assist the craft in clearing the shallow water.

b. Broaching frequently occurs when a powerful crest hits a beached craft. The power of the broken crest hitting the beach depends upon the height of the breakers and their distance from the waterline and is followed by a violent uprush on the beach. The danger of broaching is great unless the craft can be held firmly against the beach. It is much more difficult to prevent the broaching of the single screwed LCVP than the twin screwed LCM. With a wide surf zone, on the other hand, the broken crests expend their energy as they advance through shallow water, the uprush on the beach is gentle and the risk of broaching is greatly reduced. Where the width of the surf zone changes with the stage of the tide the difficulties to be expected in landing operations will also depend upon the tide. Long shore currents are a frequent cause of broaching.

704. FLOW-IN OF LCAC. Plow-in is when the forward skirt of the LCAC collapses inward causing excessive yawing and side slip to develop, with the stern breaking from the surface. Plow-in generally occurs from excessive bow down trim, coupled with extremely high speeds at high propeller pitch angles. Plow-in will normally occur during the beach to water transition into the surf. The danger of plow-in will increase as surf height increases or the gradient of the beach steepens.

CHAPTER 8

SURF IN AMPHIBIOUS PLANNING

801. PLANNING FOR WAVE, BEACH AND SURF CONDITIONS. In order to properly plan and carry out combat amphibious landings, it is necessary to have INTELLIGENCE information and correct evaluation. The primary aim of the studies made at this time is to determine certain oceanographic factors which affect an amphibious operation. The following sections deal with methods of obtaining pertinent surf information desirable in planning a landing. Some uses of the information obtained are:

a. Selection of Beaches. Within limits set by strategic and tactical considerations, landing areas should be selected with reference to surf and beach conditions under exposure to different wave conditions. After the hydrography of each area has been obtained, wave refraction diagrams should be drawn to show the variations in surf conditions along the beach for wave periods and deep-water directions over the entire possible range. Alternative landing plans for each landing area will be desirable if the analysis shows markedly different surf conditions under exposure to waves of different possible directions and periods.

b. Selection of Ships, and Vehicles. The selection of ships and landing craft with relation to anticipated surf conditions should be completed during the early planning of an operation. It is possible to plan for surf at this stage only on a statistical basis, but the probability of light or heavy surf action at the time and place of the landing should not be ignored. On shorelines noted for severe surf, there are some days of relative calm, and on shores where the surf is normally light, there are usually some days of heavy surf, but the assumption of abnormal conditions is unwise.

c. Training and Briefing of Personnel (Beach Masters, Coxswains, Salvage Boats, etc.)

(1) Selection of Training Areas. At least a portion of the personnel involved should be exposed to surf and beach conditions similar to those at the selected landing areas.

(2) Briefing of Landing Force Personnel. A combination of aerial photographs and sketches should be prepared in advance from which can be selected, just prior to the assault, those conforming most closely to the expected landing conditions. Transparent overlays might carry instructions for the different functions and levels of command. Surf photographs from the shore, from the sea and from the air should be available for a similar beach under a variety of surf conditions and a selection made to represent the expected conditions. Briefing should cover the following items:

- (a) Size and type of breakers;
- (b) Type of surf area;
- (c) Direction of longshore current;
- (d) Tide state.

802. PLANNING STAGE

a. During the planning of an operation, the seasonal character of the surf in the area should be examined by the staff oceanographer. After reviewing the appropriate climatological data (either held locally or provided by the cognizant Naval Oceanography Command activity upon request), he can determine the probable sea and swell characteristics in the amphibious objective area. He can thus provide statistical estimates on the month or season in which unfavorable surf conditions are probable, whether landings on alternate beaches should be considered, and describe the synoptic weather situation which would favor one or the other of such beaches.

b. In order to examine the actual character of surf, he requires detailed information regarding the shape of the coast line, the slope of the beach directly above or below the low waterline, and the offshore bottom topography. Knowledge of the bottom topography is necessary for the construction of refraction diagrams

TABLE 8-1

PRELIMINARY DATA REQUIRED DURING PLANNING STAGE

Features Determined	Personnel Responsible	Methods and Sources
1. Prevailing Winds	Oceanographer or NAVOCEANCOM forecast activity	Wind roses from climatological data.
2. Prevailing sea and swell	Oceanographer or NAVOCEANCOM forecast activity	Swell roses from climatological data.
3. Beach slope	Photo/satellite imagery interpreter Intelligence	Interpretation of aerial photos. Use of H.O. Charts and other sources. Soundings. Seal Team survey.
4. Beach irregularities	Photo/satellite imagery interpreter Intelligence	Interpretation of aerial photos/satellite imagery. Use of H.O. Charts and other sources. Soundings. Seal Team survey.
5. Refraction diagrams	Oceanographer or NAVOCEANCOM forecast activity	Prepared from latest Seal Team survey or other available hydrographic data.
6. Prevailing surf	Oceanographer or NAVOCEANCOM forecast activity	Prevailing swell; refraction diagrams.
7. Currents	Intelligence Oceanographer or NAVOCEANCOM forecast activity	Research from charts and publications.
8. Tides	Intelligence Oceanographer or NAVOCEANCOM forecast activity	Interpretation from prepared tables.
9. Beach materials	Photo Interpreter* Intelligence	Interpretation of aerial photos/satellite imagery. Data compiled from publications. Seal Team survey.

Note: *Specially trained in depth determination from aerial photographs.

TABLE 8-2
DATA REQUIRED FOR D-DAY

Features Determined	Personnel Available	Methods
1. Surf and Swell conditions	OTC Oceanographer or NAVOCEANCOM forecast activity. Airborne observer. Seal Team	Surf and swell forecasting procedures. Surf observers make reconnaissance flights.
2. Tides	OTC Oceanographer and Intelligence Officer or NAVOCEANCOM forecast activity	Calculations from H.O. reports and Seal Team information
3. Currents	OTC Oceanographer and Intelligence Officer or NAVOCEANCOM forecast activity.	Pilot charts, tidal current table, navigation charts, sailing directions, and coast pilots.
4. Depth of water and beach slope	Photo/satellite imagery Interpreter, Oceanographer and Airborne observer. Seal Team	Wave velocity method. Wave length method.
5. Beach features (bars, troughs)	Photo/satellite imagery Airborne observer Seal Team	Photo/satellite imagery Interpretation. Note changes due to waves and surf. Soundings.
6. State of the sea	Oceanographer or NAVOCEANCOM forecast activity.	Wave and swell forecast.

which will show to what extent any given locality is protected from, or exposed to, sea and swell from various directions; refraction diagrams are also indispensable for forecasting for a specific time.

c. The width and character of the surf zone depends upon the beach profile directly off the shoreline, including bars and other obstacles to landing operations. Navigation charts seldom show these details and all possible means of determining the beach profile should therefore be used during the planning stage. Special photographic techniques are necessary, and any program of beach studies using these methods should be initiated as early in the planning stage as possible. The trained oceanographer is familiar with these methods based on aerial photographs of wave characteristics, and when these can be used he should cooperate with the photo/satellite imagery interpreter to ensure the best possible results.

d. The offshore bottom topography from which the refraction diagram is drawn is usually permanent, but the beach near shore will change with waves and tides. The effect of wave action on the beach features in turn depends upon the beach material, and the latter is also important to traffic across the beach. Some information about beach material can be obtained from repeated photographic surveys, particularly if a geologist can assist in the examination of the photograph.

e. Accurate knowledge of the tides is needed. This is particularly true where the tide range is large and where the beach has an uneven profile with offshore bars, which are exposed or barely covered by water at low tide. Tide tables are available for the Pacific areas, but for the China coast the

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information is incomplete and should be supplemented by observations in order to make adequate predictions possible. Table 8-1 lists the different features which can be examined during the planning stage and by whom the information can be best found.

f. The Oceanographer should be required to initiate forecasts and to have them verified by aerial reconnaissance at least one month before D-Day. This will permit him to make corrections for local variations so that his forecasts for D-Day are based on first hand knowledge of local conditions.

803. INFORMATION FOR D-DAY

a. The surf conditions on a beach of known exposure and profile can be forecast about 24 hours in advance by oceanographers who have received training in this particular form of forecasting. The forecast features comprise:

- (1) The width of the surf zone;
- (2) The significant breaker height;
- (3) The depth of breaking;
- (4) The angle of the breakers to the beach;
- (5) The wave length directly outside the breaker line;
- (6) The longshore currents;
- (7) Period of breakers;

b. In order to forecast the surf condition on any beach, the deepwater waves (sea or swell) must be known. These can be determined in one of two ways: from weather maps, or from direct measurement offshore. Direct measurements are required if adequate weather maps are not available and are always desirable in order to check results from weather maps. Table 8-2 lists data required for D-Day.

c. From a knowledge of the deepwater waves and the bottom topography surf conditions can be predicted. In the case of alternate beaches, forecast will indicate where surf conditions are most favorable.

d. At this point, it is considered important to bring to the attention of amphibious planners, the factors influencing the accuracy of surf forecasting. A large portion of the information needed for a surf forecast is usually derived from a previously prepared weather analysis.

e. The purpose of the analysis is to determine which areas of open ocean may be considered as wave generating areas. Presuming that correct and adequate information is available for weather analysis, it may be assumed that if complete and adequate hydrographic information is available, the resultant surf forecast will be accurate. An experienced surf forecaster considers a forecast accurately verified if the observed breakers are within the following limits:

<u>Forecast height</u>	<u>Tolerance allowed for verification</u>
0 - 5 Feet	Plus or minus 1 foot
5 - 10 Feet	Plus or minus 2 feet

It should be borne in mind that a scarcity of weather reports, imperfect communication facilities, or erroneous hydrographic data will seriously limit the ability of the forecaster to prepare a correct surf forecast.

f. Surf intelligence does not end with D-Day. In planning the landing of supplies and replacements, a knowledge of surf conditions can be very helpful. During the supply phase at Omaha Beach, Normandy, forecasts of the ending of heavy surf conditions were found particularly useful in scheduling the resumption of unloading operations. After the objective is secured, a knowledge of beach and surf conditions is valuable in choosing and developing harbors and anchorages.

804. PERCENTAGE OF CASUALTIES IN LANDINGS WITH LCVP AND LCM

a. In order to determine how many casualties may be expected under various surf conditions, about 12,000 individual landings of LCVP and LCM were observed at the Amphibious Training Base at Coronado, during the later stages of World War II. The number and causes of the casualties were observed by experienced coxswains capable of recognizing mishaps caused by either poor seamanship or the surf. In order to bring out the effect of surf only, all casualties were eliminated which could be ascribed to inexperience. The Amphibious Base at Coronado has a beach with a steep upper slope above the low waterline and a flat slope with bars below the low waterline. At high tide, the Coronado beach has, therefore, the character of a steep beach, whereas at low tide it has the character of a flat beach with some off-lying bars. Most landings were made with breakers less than 6-feet high and under these conditions the BREAKER HEIGHT and the BEACH SLOPE were the two most important features to which surf casualties could be related.

b. The results of the studies are shown in Table 8-3 below and Figures 8-1 and 8-2. The casualties are expressed by the percentage of craft that were put out of operation during an operation in which 25 or more single landings were made. The relations between casualties, breaker heights and beach slopes are represented by bands. These show the range in significant breaker height at which any given percent of casualties may be expected.

From the figures, it is found that the breaker heights which cause 20 percent casualties on beaches of different slopes are:

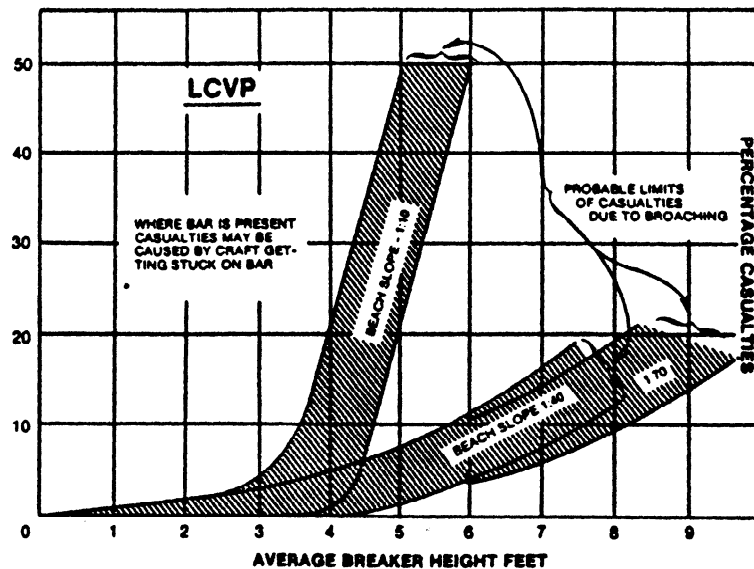
TABLE 8-3
LANDING CRAFT VS BEACH SLOPE (20% CASUALTIES)

<u>TYPE OF CRAFT</u>	<u>BEACH SLOPES</u>			
	<u>1:10</u>	<u>1:25</u>	<u>1:40</u>	<u>1:70</u>
LCVP	4' - 5'	6' - 7'	7.5' - 9'	8' - 10'
LCM	8' - 10'	8' - 10'	8' - 10'	8' - 10'

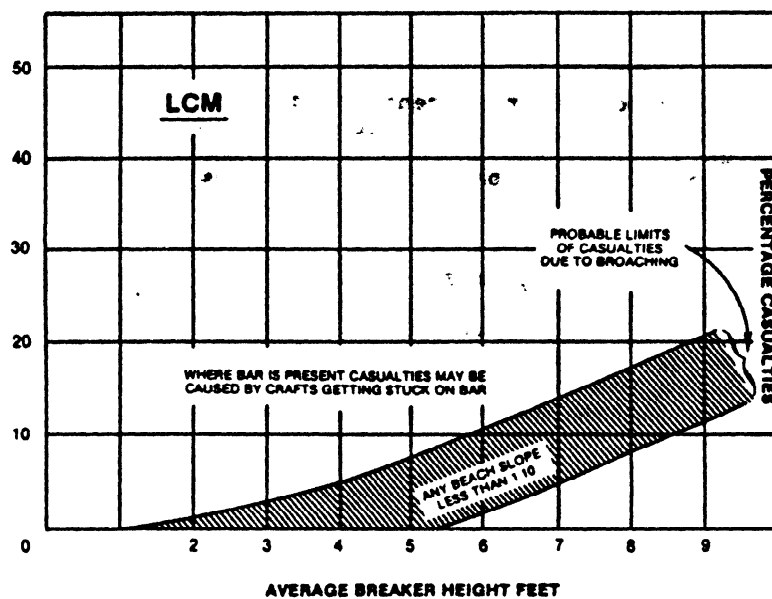
c. Corresponding values for other percentages can be interpolated from the graphs. For the LCVP there is a striking effect of the beach slope, but for the LCM the beach slope is unimportant as long as the steepness is less than 1:10. Experience on Iwo Jima shows it is probable that on steeper beaches many LCM would also broach with breakers even lower than 5 or 6 feet.

d. The information in Figure 8-1 and 8-2 is derived from observations of landings with unloaded craft which spent a very short time on the beach. It is believed that in the absence of bars nearly similar results will be obtained if the craft carry troops and stay on the beach for a few minutes only, but that the percentage of casualties will be considerably greater if the craft carry supplies. With loaded craft and in the presence of shallow bars many more casualties can be expected because of craft getting hung on the bar.

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GRAPH OF CASUALTIES LCVP
FIGURE 8-1



GRAPH OF CASUALTIES LCM
FIGURE 8-2

805. LIMITING SURF CONDITIONS FOR TRAINING OPERATIONS. Limiting surf conditions for training operations shall be set by the command concerned. These limits shall not exceed conditions acceptable for routine operations as calculated by the objective method outlined in Chapter 11 (Modified Surf Index).

806. INFLUENCE OF WINDS ON BOAT OPERATIONS. Winds, of course, give rise to all waves with which an amphibious operation is concerned. In addition to this, wind affects the breaker type as described more fully in other sections of this publication. It also affects the speed and control of landing craft in the surf zone. The effect of winds in modifying the breaker type is frequently advantageous, however, landings have been made through the surf during a thirty knot onshore wind without difficulty. However, when an offshore wind (greater than 10 knots) is present, the following changes in the surf conditions will normally take place; (1) the width of the surf zone will normally increase, (2) there will be an increase in the steepness of the waves, and (3) a greater percentage of plunging type breakers will appear. Furthermore, any subsequent increase in the wind speed will also produce an increase in the latter two parameters. This combination, of plunging surf and an offshore wind, frequently forms dense streams of spray (Horse's Manes) which can cause a significant reduction in surface visibility.

807. INFLUENCE OF VISIBILITY ON BOAT OPERATIONS. Fog and rain have little influence on an amphibious operation unless the surf zone is obscured. It is extremely dangerous to put into a beach when the surf characteristics cannot be estimated. There is never any justification in assuming that the breaker condition will remain constant for even a short period of time and it is dangerous to assume that light surf still exists after fog or rain has obscured it. The energy front of a system of waves arrives on a beach quite suddenly and the wave height can increase from very low heights to an intense surf in less than one hour.

808. PLANNING FOR EMPLOYMENT OF LANDING CRAFT AIR CUSHION (LCAC). Technical characteristics and capabilities of (LCAC) are covered in COMPHIBGRU 2/CG MCDEV & EO CEN TACMEMO PZ 005770-1-85, DH 7-15, dated November 1985.

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CHAPTER 9

CONSIDERATION OF BEACH FACTORS

901. BEACH TYPES

a. The beach type is actually the long term result of the type of waves to which it is subjected and the supply and type of sediment available. These processes, which may involve a change of beach type, normally take place at a minute rate, except where altered by adjacent jetty construction, dredging or other human intervention. These long term changes do not enter into this discussion. Certain seasonal changes will take place which will certainly affect the operation of amphibious craft, but these are difficult to forecast.

b. For the purpose of this discussion the gradient of beaches will be defined as the overall slope of the bottom from the high water mark to the seaward limit of the slope upon which the maximum breakers occur. Thus beaches in certain areas may be measured only to 10 to 12 feet of water and for others to 50 to 60 feet.

902. STEEP BEACHES

a. Gradients. Steep beaches have gradients of more than 1:15 (7%). During normal conditions only one wave exists in the surf zone of steep beaches at any one time. That is, a wave breaks, the swash runs up the beach face and backrush reaches its lower limit before another breaker occurs. Steep beaches normally have plunging breakers, but if they are very steep (1:4 to 1:7; 25% to 14%) they sometimes are so balanced that the breakers are of an unusual type. In this case the backrush occurs in such resonance with the incoming breaker that this water flowing down the beach fills the curling wave form with water and the breaker, instead of plunging, "rolls over" without impact. This type of breaking apparently leads to a much more effective transformation of the breaker energy into translation and the swash flows up the beach with unusual velocity and reaches a height on the beach face much greater than the height of the waves. All phases of this resonant condition have been observed. Often the period of the waves and the swash are exactly equal and every wave breaks in this fashion. Sometimes every second wave is of this type and the other plunges with great violence. As is usual for all beaches, advantage can be taken of any resonant or cyclic condition to enable an operator to make his sortie at the most advantageous time. Spilling breakers are seldom if ever seen on a steep beach. The breaker described above is not as hazardous to landing operations as the plunging breaker.

b. Profiles and Profile Changes. Steep beaches tend to become steeper during a period of calm seas. The summer berm advances outward and underwater berms and bars tend to disappear. The beach face may become very steep. A beach face of 1:3 or 35% has existed at Carmel River Bight during summer conditions. They tend to become flatter in profile under the influence of high seas and seas at an angle and to form a bar or berm offshore at the breaking point. This will be a berm for very steep beaches and a bar for moderately steep beaches.

c. Materials. Generally steep beaches are composed of coarse sand particles, pea gravel or gravel.

d. Currents. When waves break at an angle on such beaches the speed of the currents will be high. They will exist throughout the surf zone and for some distance to seaward.

903. BEACHES OF MODERATE GRADIENT

a. Gradient. Beaches with slopes of 1:15 to 1:30 (7% to 3%) may be considered beaches with moderate gradient.

b. Breaker Types. Plunging breakers are less common on such beaches and spilling breakers often occur. The probabilities of each depend upon the irregularity of the beach and type of waves which exist. This has already been discussed at some length. If a bar exists, plunging breakers may occur at low tide and become spilling at high tide. High, long period swell will usually plunge at both high and low tide. The rate at which the instability is reached is an important factor in determining the breaker type. When spilling occurs on the bar the wave will frequently reform and plunge on the beach face.

c. Profile and Profile Changes. Beaches of moderate gradient will usually have an offshore bar at all seasons of the year, unless they are in partly protected bights or bays.

This bar becomes more pronounced when high waves exist and the beach face becomes flatter. During a period of low waves the beach face becomes steeper and the bar tends to disappear or become discontinuous. Beaches of these slopes rarely have more than one bar.

d. Materials. These beaches are mostly composed of moderately fine sand. They may have a gravel berm at extreme high water.

e. Currents. When a bar exists, currents are always present in the channel shoreward of the bar. When the waves arrive parallel to the beach these currents will be of low velocity but when the breakers are at an angle they may reach a velocity of four knots. This flow of water normally follows the channel for some distance and then flows out over the bar at various low points 400 to 5000 feet apart. These partial channels are called rips and currents flowing to sea may be very strong. If the beach face is steep, strong currents will also exist in the inner surf zone but if it is a moderate slope they will be weak.

904. BEACHES OF GENTLE, MILD, AND FLAT GRADIENTS

a. Gradients. Beaches with slopes of 1:30 to 1:300 (3% to 0.3%) may be considered as beaches of gentle, mild, and flat gradients.

b. Breaker Types. Plunging breakers are less common on these beaches and spilling breakers are the general rule. When plunging breakers are observed they usually result from a temporary steep section of the profile. Breakers which peak up almost to a position of instability for a considerable length of time are very likely to spill because of their susceptibility to disturbing factors. These beaches frequently have several bars and it has often been noted that when a combination of long period swell and short period wind waves exist a certain amount of spilling will take place on the outer bar. This spilling may result in the obliteration of the wind waves and the dominant swell may reform in the channel behind the bar and plunge on one of the subsequent bars or upon the beach face. It has, of course, lost energy in the spilling process and will not be as high as it would have been had it broken in a plunging manner previously. The increased hazard incident to plunging breakers may result in an impassable surf on one of the inner bars even though the spilling surf is quite moderate on the outer bars.

c. Profile and Profile Changes. Beaches of flat gradient will usually have several offshore bars at all seasons of the year unless they are partly protected. On the northern Oregon and Washington coast these beaches have three or four bars during summer conditions which may be in some way related to the greater range of tide in the regions of these beaches. That is, the tide range is comparable to the normal breaker height. Since the water level remains for a longer time at high water and at low water than it does at intermediate points there is apparently a process which attempts to set up an equilibrium of the beach at each of these stages. This coupled with the fact that these beaches are subject to waves from two directions and of two general types may be responsible for the appearance of three bars, each bar and the beach face, representing a partial adjustment to a combination of tide stage and wave characteristics. This is partly confirmed by the extended period of heavy western swell. The beach face on such beaches is always suitable for amphibious operations except at extreme high tides, during heavy weather when the beach may be eroding at certain points, and is thus impassable to travel along the beach face by tracked vehicles.

d. Materials. These beaches are composed of fine sand. A pea gravel or gravel beach face is occasionally encountered at the mouths of small creeks.

e. Currents. In the channels between the bars, currents may be very strong. This is especially the case when waves arrive at an angle. There is very little current at the beach face under any circumstances. The flow of water which is built up is between the bars. The channels throughout the different bars may not be contiguous. In fact, where a channel occurs through the inner bar the next bar to seaward is likely to be more shoaling at this point than elsewhere.

905. EFFECT OF EXPOSURE ON BEACH TYPE

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a. In general, beaches which are subjected to waves from a variety of directions and of a variety of periods and heights are of a much more complex nature than the beaches which are affected by more limited conditions. The simplest case is that of a beach in the head of a bay or bight where the only waves reaching the beach are those which have come through the entrance and refracted and diffracted. This results in the screening out of a great number of different period waves and thus the beach is affected by certain limited types of waves only. Beaches which are so located are adjusted in such a manner that these waves arrive parallel to the beach, unless disturbed by current caused by freshets or tidal fluctuations. The adjustments result from the fact that the waves, if originally at an angle to the beach, produce a transport of the beach material in such a direction and manner so as to bring about this balance in profile. After this balance has been obtained the waves striking the beach parallel cause a general rise in water level within the surf zone. The variation of height of any breaker throughout the line of the beach is gradual and there is no direct compulsion for this increased head of water to escape in any particular manner. Thus small irregularities in the beach set up a series of partial channels throughout the surf where this transported water escapes. On beaches where conditions are very constant these cup-like channels are unusually evenly spaced and, on various beaches, may vary in length along the beach from 20 to 500 feet or more. These cusps or undulations of the beach may cause shells and other materials to be deposited on the crest and these may interfere with the activities of LARC both in landing and traveling along the beach. A landing point always should be selected so that the LARC lands in the trough of these cusps rather than upon the crest. Broaching is much less of a hazard in the trough.

b. Beaches in large wide open bays or extremely long beaches which are subjected to waves from a constant angle frequently do not set up this balanced condition mentioned above. This results from the fact that the points or headlands confining the beach are so limited in seaward extent that regardless of the transport of materials in the direction in which the waves are traveling the transport merely continues indefinitely without effectively changing the trend of the beach. This condition is noted through almost all the beaches immediately to the south of Point Conception. Such beaches possess relatively simple profiles since forces acting upon them are of a nearly constant direction.

c. Beaches which are affected by the waves coming from many directions and waves of varying types are usually of a complex profile. They are affected by currents which change in direction from day to day and their profiles are likely to differ greatly at closely adjacent points. They have irregular discontinuous bars of varying number, flat and steep sections and channels or rips throughout the surf zone at irregular intervals of 300 to 5000 feet. This condition is well exemplified at a number of points along the Pacific Coast where a continuous beach curves farther and farther to seaward at the southern extremity. Thus the beach from Pismo to the mouth of the Santa Maria River is, at Pismo, affected by waves primarily from one direction. The beach profile here is smooth and consistent. Between Pismo and the Santa Maria River the beach curves gradually to seaward and is subjected more and more to waves at a variety of angles is of a completely disordered type as described above. In general, therefore, if any part of the beach has some protection so that waves from one direction are eliminated, the profile and beach type will be more regular than it is elsewhere. This protection may not necessarily be a headland, island or jetty. For example on Clatsop Spit near the mouth of the Columbia River, part of the beach is protected from Northwest seas during the ebb tide from the river, and the beach is somewhat more regular in profile than it is farther to the south.

906. THE SEASONAL CHANGE OF BEACH TYPE. During extended periods of low waves, beaches may build high berms on the foreshore with very steep profiles of the beach face. Bars tend to disappear or become discontinuous. During period of high waves the beach face becomes less steep and the bars become more pronounced. This flattening of the beach face, of course, involves cutting back of the berm and temporary steep banks may be formed which seriously impede the operation of amphibious vehicles. Beaches which have formed cusps under the influences of waves arriving parallel to the beach over extended periods, will have these cusps truncated or differently spaced when the wave conditions change. The beach may then have a series of steep escarpments where the crest of each cusp has been cut

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away, and soft sand newly deposited in the troughs of the old cusps. If the cusps were originally large this may result in very difficult operation conditions. Any beach which is undergoing or has recently undergone a distinct change may be a difficult beach upon which to operate vehicles.

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CHAPTER 10

METEOROLOGICAL PLANNING FOR AMPHIBIOUS EXERCISES

1001. THE OPERATIONAL WEATHER FACTOR. This is defined as the influence exerted by weather and climate on the selection of a landing area and the target date for an amphibious exercise. The applications of the Operational Weather Factor and command decisions based on weather during the conduct of an amphibious exercise are the responsibility of the Officer Conducting the Exercise. If meteorological personnel are not attached to the staff of OCE, information concerning weather, climate and surf would be requested from the next higher amphibious command in the local area having a meteorological unit or, when such services are not available, from the nearest Naval Oceanography Command activity.

1002. METEOROLOGICAL REQUIREMENTS OF THE PLANNING PHASE. Whenever feasible, a visit to the cognizant Naval Oceanography Command activity should be arranged, to assist the intelligence officer during the planning stages of the exercise. The following planning details are listed for guidance:

- a. The operational weather factor and its influence on selection of the landing area and D-Day.
- b. Surf and weather information, including reports, forecasts and observations, required for successful completion of the exercise.
- c. Existing weather facilities, including routine weather broadcasts, facsimile products and local weather forecasts.
- d. Special weather facilities, including broadcasts, observations, forecasts, equipment and personnel.
- e. Specific communication channels and times of transmission of weather information.
- f. Weather and surf reporting procedures including originator, addressees, time of observations, station designator, weather codes, times of transmission to be used during the operational phases of the exercise.
- g. Special weather advisories covering any heavy weather conditions endangering the task force. This will include small craft warnings, gale/storm warnings and hurricane advisories. Dissemination of such weather information to all commands of the task force is the responsibility of the OCE.

1003. METEOROLOGICAL SERVICES. An adequate surf and weather forecasting unit for peacetime amphibious exercises consists of an Oceanographer, trained in surf forecasting, and Aerographer's mates. Before any landing exercise, surf forecasts should be requested from the Naval Oceanography Command Center/Facility in whose area of responsibility the landing occurs. Unofficial requests for services, particularly for providing SUROBS, can lead to confusion and unsatisfactory results. In order to ensure provision of adequate forecast and SUROB services, and that responsibility is fixed, services will be provided only when requested through prescribed channels.

1004. SURF FORECASTS

a. Suggested Schedule. When the exercise includes a landing operation, optimum utilization of meteorological forecast support is recommended. Therefore, in addition to those services provided by the OCE Staff Oceanographer, the cognizant Naval Oceanography Command activity should also be tasked with providing surf forecast support for the exercise. Listed below are the NAVOCEANCOM activities, and their geographical area of responsibility.

(1) Surf Forecast (SURFCST) Schedule. Surf forecasts are normally issued every 12 hours, and are valid for a 24 hour period. Procedures for requesting surf forecasts are contained in paragraph 1004(d). The following schedule of surf forecasts is considered adequate when an exercise includes a landing operation.

TABLE 10-1

<u>LOCATION OF EXERCISE</u>	<u>COGNIZANT/ NAVOCEANCOM ACTIVITY</u>	<u>TIMES OF FORECAST</u>
Southern California	NAVOCEANCOMFAC San Diego, CA	0600 and 1800 (LST) or as required by the OCE
Other West Coast, East/MIDPAC Beaches and Hawaii	NAVWESTOCEANCEN Pearl Harbor HI	Same as above
Western Pacific and the Indian Ocean	NAVOCEANCOMCEN Guam, MI	Same as above
East Coast, Gulf of Mexico and Caribbean beaches	NAVEASTOCEANCEN Norfolk, VA	Same as above
Mediterranean	NAVOCEANCOMCEN Rota, SP	Same as above

b. Elements of a surf forecast (SURFCST)/surf observation (SUROB). The following elements will be included in the SURFCST/SUROB:

- (1) ALFA - Significant Breaker Height. The mean value of the 1/3 highest breakers on the beach measured to nearest half-foot.
- (2) BRAVO - Maximum Breaker Height. The highest breaker observed/forecast during the period measured to the nearest half-foot.
- (3) CHARLIE - Period. The time interval between breakers measured to the nearest half-second.
- (4) DELTA - Breaker Types. Spilling, plunging or surging preceded by the numerical percentage of each.
- (5) ECHO - Angle of Breaker with the Beach. The acute angle, in degrees, a breaker makes with the beach. Also indicate the direction toward which the breaker is moving, RIGHT flank or LEFT flank.
- (6) FOXTROT - Littoral Current. The longshore current, measured to the nearest tenth knot. Also given is the direction toward which a floating object is carried, RIGHT flank or LEFT flank.
- (7) GOLF - Surf Zone. The predominant number of breakers in and the width of the surf zone in feet.
- (8) HOTEL - Additional Remarks. Information important to landing operations, (wind direction and velocity, visibility, debris in the surf zone, secondary wave system if present, dangerous conditions, etc.).

c. Sample Surf Forecast

SURFCST WILSON COVE VALID 180600U to 181800U
ALFA 3 PT 5
BRAVO 4 PT 5
CHARLIE 8 TO 10
DELTA 100 SPILLING
ECHO 5 DEG RIGHT FLANK
FOXTROT 0 PT 5 RIGHT FLANK
GOLF 3 TO 4 LINES 150 FT
HOTEL DELTA BECOMING 50 PLUNGING 50 SPILLING BY 181200U

d. Procedures for Requesting Surf Forecasts (SURFCST). The need for accurate surf forecasts during an amphibious exercise can not be overly stressed. The accuracy of a surf forecast can be significantly reduced when the designated forecast activity is not made aware of various landing area data, that could have an effect on local surf conditions. Supplemental data, such as beach surveys, refractions diagrams, and a large scale chart depicting each landing beach and its exposure to the open ocean, would be extremely helpful to the forecasting activity. This data may be provided via separate correspondence or, when feasible, during a visit to the cognizant NAVOCEANCOM activity during the planning stages of the operation. A sample SURFCST request is given in Figure 10-1.

1005. SURF OBSERVATIONS

a. Surf Observations (SUROB) Services. The safety and success of amphibious landings is largely dependent upon known surf conditions. These surf conditions are reported by various individuals, usually Seal Team, Beachmaster or Force Recon personnel, depending upon the specific operation and are the key to major decisions. It is essential that SUROBS be accurate and timely. It should be noted, however, that nighttime observations are not nearly as reliable as daytime observations. Darkness inhibits the observers ability to determine such critical parameters as breaker height, breaker type, breaker angle, etc. The validity of nighttime observations can be checked by reviewing the trends in modified surf indices established by the preceeding daytime observations. That is, did the last few daytime observations indicate that the modified surf index was increasing, decreasing, or remaining fairly constant. This information in conjunction with the current meteorological situation will indicate if any large variations between the daytime observations and nighttime observations are justified. Seal Team personnel should be sent in tactically prior to the landing to conduct initial surf observations until conditions permit a beachmaster representative to assume the responsibility. The duties of the beachmaster representative is to provide CATF and PCS with periodic surf observations at intervals designated by CATF, and to advise promptly when any condition exists which may adversely affect the landings. He shall maintain direct communication with CATF and the PCS. In addition, the beachmaster shall be prepared to utilize appropriate emergency visual signals including red flares for "turn-away".

b. Scheduling SUROBS. Operations orders for amphibious landings should provide for the taking and transmission of SUROBS, usually in the Intelligence Annex, Communications Annex, and Reconnaissance Annex. The following schedule of observations is listed for guidance. The number of observations required will vary with the scope of the exercise.

TABLE 10-2

INTERVAL SUROBS	TIME PERIOD	OBSERVATIONS TIMES (LOCAL)
Twice daily	D-3 to D-2	0615* and 1815*
6 Hourly	D-1 to H-4	0615*, 0915, 1215, 1815*, etc....
Hourly	H-4 to H-hour	See note 1
3 times daily	H-hour to completion of exercise in addition to any additional requirements prescribed by the OTC, or when in the opinion of of the Beachmaster, any significant changes in the surf conditions occur*	

*Denotes observations that will be forwarded, via Naval message, to the NAVOCEANCOM activity providing forecast support. It is the responsibility of the Staff Oceanographer, or someone designated by the OTC, to ensure that this data is properly encoded and transmitted.

NOTE 1: At least one observation from the H-4 to H-hour time frame will be transmitted to supporting NAVOCENCOM activity.

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SAMPLE SURF FORECAST REQUEST

R 071247Z OCT 79

FROM: COMPHIBRON TEN

TO: AIG SEVEN SIX ZERO EIGHT (NOTE 1)

INFO: COMPHIBGRUEASTPAC

COMNAVSURFPAC SAN DIEGO CA

NAVOCEANCOMFAC SAN DIEGO CA (NOTE 2)

CONFIDENTIAL //N03140//

EXERCISE VARSITY PICNIC WX/SURFCST REQUEST (U)

A. SEAL TEAM ONE BEACH SURVEY OF 17 JAN 79 (PASEP)

B. COMNAVSURFPAC/COMNAVSURFLANTINST 3840.1A

C. EXERCISE VARSITY PICNIC LOI (PASEP)

1. (C) DURING THE PERIOD 13-26 DEC 79, COMPHIBRON TEN WILL BE CONDUCTING AMPHIB LANDINGS AT THE FOLLOWING PLACES TIMES

A. SILVER STRAND (YELLOW BEACH) 1300U (130800Z) TO 181200U (182000Z) (NOTE 3)

B. CAMPEN (GREEN AND WHITE BEACHES 161200U (162000Z) TO 261200U (262000Z)

2. REF A SPECIFIES EXACT BEACH LOCATIONS AND HYDROGRAPHIC INFO

3. (U) IAW REFS B AND C, REQ 24 HR WX AND SURFCSTS BE ADDRESSED TO CTG ONE SEVEN NINE PT TWO, INFO TU ONE SEVEN NINE PT NINE PT TWO PT ONE, COMNAVSURFPAC, AND COMPHIBGRUEASTPAC EVERY 12 HRS TO LANDING SCHEDULE IN PARA (1) ABOVE. (NOTE 4).

4. (U) SUROBS WILL BE FORWARDED IAW REF B TO ACTIVITY PROVIDING WX/SURFCST.

//END

DECL: 26 JAN 80

NOTE 1: Use AIG 7641 if for Atlantic Ocean, Mediterranean Sea

NOTE 2: When the request is for the Southern California area, NAVOCEANCOMFAC San Diego should be an INFO addree. All other forecast activities are covered under the respective AIG (7608 or 7641).

NOTE 3: Both the Local Standard Time (LST) and Zulu (Z) time should be provided. The resultant forecast should also list both LST and ZULU times.

NOTE 4: When special exercise AIG(s) are used, it is imperative that the cognizant NAVOCEANCOM activity and the serving NTCC receive a copy of the communications Annex to the OPORD or LOI to ensure delivery of the forecast message traffic, and that the period of environmental support does not exceed the duration of the AIG(s).

FIGURE 10-1

c. Method of Observation

(1) General. A surf observation form, similar to the sample in Figure 10-2, is required to make a SUROB. One hundred successive breakers are observed and the type and estimated height is entered in the 100 spaces provided.

(2) Breaker Types and Height. Determine breaker type and estimated height according to the criteria set forth in Chapter 4 (Breakers), paragraphs 401 and 407.

(3) Breaker Angle (ECHO). Breaker angle is simply the angle a breaker makes with the beach. It is always determined as moving toward the right or left flank (for clarification of "left flank" and "right flank" see paragraph 1006 and Figure 10-3). The breaker angle illustrated in Figure 11-1 is 5 degrees toward the right flank. The correct entry is shown in the sample form in Figure 10-2. If several breaker angles exist and breaker lines are moving toward both flanks the following entry could be made: 10-20 toward R/L flank. If the breakers are parallel to the beach, the entry would be: 0 toward R/L flank.

(4) Littoral Current (FOXTROT). Littoral current moves parallel to and adjacent to the shoreline. Littoral current is determined by throwing an object that will float into the water immediately in front of the innermost breaker and by pacing off the distance in feet that it moves in one minute. Each ten feet of movement is equal to one-tenth knot of littoral current. For example, an object that moves eighty feet towards the right flank in one minute would indicate a littoral current of 0.8 knots. The correct entry is shown on the sample form in Figure 10-2. Several measurements should be made and the results averaged to ensure that the most representative current is reported.

(5) GOLF. The surf zone is the area extending from the outermost breaker line to the limit of the uprush on the beach. GOLF is determined by merely counting the number of breaker lines and estimating the width of the surf zone.

(6) HOTEL. This section is used to report any significant factors that might influence successful boat operations. Some mandatory remarks are:

(a) Relative wind direction--estimate wind speed and determine wind direction in conjunction with Figure 11-1. Wind direction is always reported as the angle between the point from which the wind is blowing and a line normal to the beach, the flank toward which it is blowing and whether it is blowing offshore or onshore (e.g., REL WIND 0450 15 KTS R FLANK ONSHORE).

(b) Weather--report presence of rain, thunderstorms, lightning, etc.
Example: HEAVY RAIN/THUNDERSTORM 10 MILES SE.

(c) Visibility--estimate visibility in miles. Report obstructions to vision. Example: VSBY SEAWARD UNRESTRICTED, VSBY INLAND 2 MILES FOG

(d) Secondary wave system--(See paragraph 508). Report height, period, and angle.

(7) ALFA. ALFA is computed by finding the average height of the highest 33 observed breaker heights. To determine the average, go back to the observation form and count the number of times that the highest breaker occurred. In the sample form, 5.5 feet was the highest height and it occurred only once. Multiply 5.5 by 1 to obtain the proper entry for the product column of the wave height computation section. At this point, go back and count the number of times that the next highest breaker height occurred. The next highest breaker was 5.0 feet and it occurred 4 times. The entry for the product column is 5.0 times 4 or 20.0. Continue this process until the occurrence column totals 33. Note that although a breaker height of 3.5 feet occurred 15 times, only 4 occurrences were used because only four 3.5 foot heights were needed to bring the occurrence column total to 33. Finally, the product column is added and the total divided by 33. Enter ALFA to the nearest half foot.

(8) BRAVO. BRAVO is the highest breaker observed. In the sample observation it was 5.5 feet.

(9) CHARLIE. Wave period is determined in the wave period computation section of the observation form. The sample observation began at 10 minutes and

10 seconds past the hour. It ended at 22 minutes and 15 seconds past the hour, or 725 seconds later. CHARLIE is determined by dividing the elapsed time (in seconds) by the number of breakers observed (100). Enter wave period to the nearest half second.

(10) DELTA. To determine DELTA simply count the number of spilling, plunging, surging breakers observed and enter their corresponding numerical value in the appropriate section of the form. In the sample observation, 94 spilling waves were observed while only 6 plunging waves occurred.

d. SUROB Format. The SUROB format is the same as the format for the SURFCST. The SUROB number, beach designation and time of observation appear at the top of the message.

1006. CLARIFICATION OF DIRECTION. "LEFT FLANK" and "RIGHT FLANK" refer to direction right or left as seen from boats and landing craft approaching the beach. Observers recording SUROBS must ensure that the direction toward which littoral current and the direction toward which breakers are moving are reported as directions viewed from seaward.

1007. EXCHANGE OF SURF INFORMATION. Surf forecasts for routine training operations must be requested from the appropriate NAVOCEANCOM forecast activity (see paragraphs 1003 and 1004(a)), stating time limits and other requirements. SUROBS taken by a trained observer should be forwarded to the responsible forecast agency at least every twelve hours. SUROBS which reflect an unexpected change should be forwarded also.

2 JAN 1957

WAVE HEIGHT OBSERVATIONS				
P - PLUNGING S - SPILLING X - SURGING		TIME BEGAN 10 MIN 10 SEC		
4.0S $\begin{smallmatrix} P \\ S \\ X \end{smallmatrix}$	2.5S $\begin{smallmatrix} P \\ S \\ X \end{smallmatrix}$	3.0S $\begin{smallmatrix} P \\ S \\ X \end{smallmatrix}$	4.0S $\begin{smallmatrix} P \\ S \\ X \end{smallmatrix}$	2.5S $\begin{smallmatrix} P \\ S \\ X \end{smallmatrix}$
4.5S	4.0S	3.0S	3.0S	2.5S
3.5S	4.0S	4.5S	3.5S	3.5S
3.5S	3.5S	2.5S	4.0S	3.5S
4.0S	2.0S	2.5S	3.5S	4.0S
2.5S	1.0S	1.0S	2.5S	1.0S
3.0S	1.5S	4.5S	2.5S	2.5S
3.5S	3.0S	1.5S	1.0S	4.0S
3.0S	2.5S	1.5S	1.0S	1.5S
2.0S	3.0S	2.0S	1.0S	4.0S
2.5S	4.5S	1.0S	2.5P	3.5S
4.0S	4.5P	1.0S	2.5P	3.5S
4.0S	5.0S	2.5S	3.0S	1.0S
3.5S	2.5S	2.0S	2.5S	3.5P
4.5S	1.0S	4.5S	2.0S	4.5S
5.0S	1.0S	4.5S	5.0S	5.0S
3.5S	3.0S	3.0S	4.0S	3.0S
2.0S	3.5S	3.5S	2.5S	5.5S
2.5S	1.5S	4.0S	2.0P	4.5S
4.0S	1.5S	4.0S	2.5S	2.0S

TIME ENDED 22 MIN 15 SEC

WAVE PERIOD COMPUTATION	
ELAPSED TIME 12 MIN 05 SEC	
TOTAL SECONDS = $\frac{725}{100} = 7.25$ = CHARLIE	

NOTE: (ECHO - FOXTROT)
Right or Left Flank as seen from Seaward

SURF OBSERVATION REPORT

SUROB NO. ONE RED BEACH

10 OCTOBER 0800

DAY-TIME OF OBSERVATION

ALFA 4 PT 0
Significant Breaker=Average of highest one third to nearest half foot

BRAVO 5 PT 5
Maximum Breaker=nearest half foot

CHARLIE 7 PT 5
Period=Five-Tenths of a Second

DELTA 5 PLUNGING 95 SPILLING

SURGING
Breaker Type=Per Cent Applicable

ECHO 45 TOWARD L FLANK
Right/Left (See Note)
Breaker Angle=Acute Angle that Breaker makes with Beach

FOXTROT 0 PT 8 KT TOWARD L FLANK
Right/Left (See Note)
Littoral Current=measured to nearest tenth of a knot One knot=100 ft per minute

GOLF 3 TO 4 LINE IN 300 FEET
SURF ZONE Surf Zone=predominant number of breakers in, and width of

HOTEL RELATIVE WIND 045/15 KNOTS

VISIBILITY 10 MILES

Fertinent Remarks=Wind-Weather-Visibility-
Secondary wave system, etc.

WAVE HEIGHT COMPUTATION

FOR HIGHEST 33 WAVES

HEIGHT X OCCURRENCE = PRODUCT

5.5 X 1 = 5.5

5.0 X 4 = 20.0

4.5 X 9 = 40.5

4.0 X 15 = 60.0

3.5 X 4 = 14.0

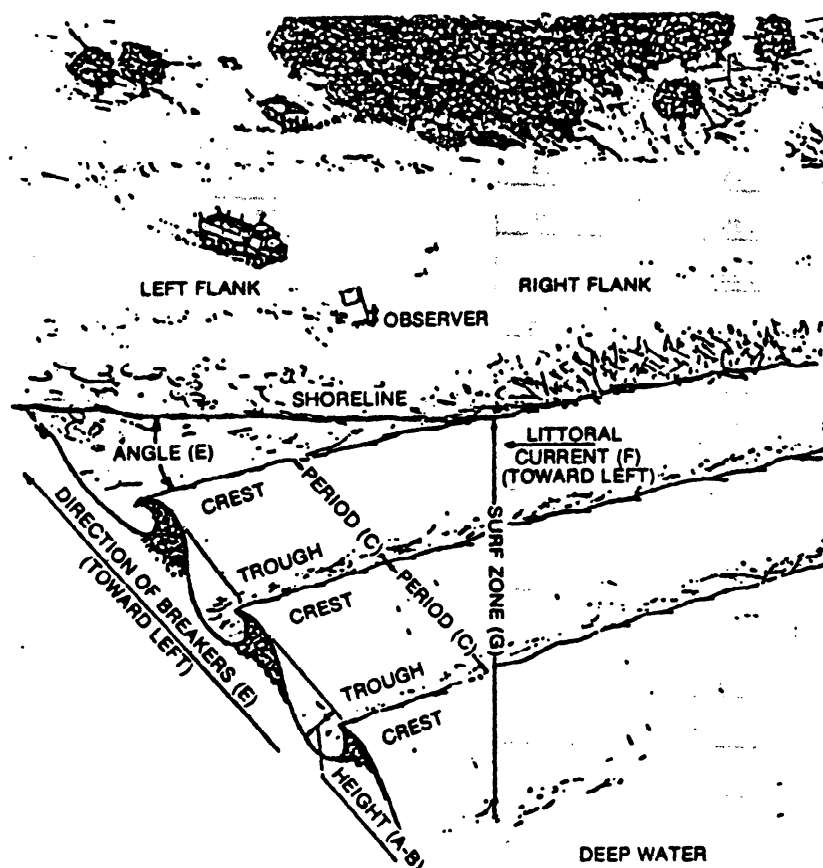
_____ X _____ = _____

TOTAL = $\frac{140.0}{33} = 4.24$ = ALPHA

FIGURE 10-2

1-50 37

DIAGRAM OF SURF ELEMENTS



- A. HT FROM CREST TO TROUGH
- B. HIGHEST OBSERVED
- C. TIME IN SEC BETWEEN BREAKERS
- D. TYPE OF BREAKER
- E. ACUTE ANGLE OF BREAKER TO BEACH
AND DIRECTION TOWARD WHICH IT IS MOVING
- F. LITTORAL CURRENT, VELOCITY AND
DIRECTION TOWARD WHICH IT IS MOVING
- G. NO. OF LINES OF BREAKERS IN
(WIDTH) FT SURF ZONE
- H. REMARKS

DIAGRAM OF SURF ELEMENTS

FIGURE 10-3

CHAPTER 11
MODIFIED SURF INDEX

1101. DEFINITION. The Modified Surf Index is a single dimensionless number which provides a relative measure of the conditions likely to be encountered in the surf zone. For the reported or forecast conditions, the Modified Surf Index provides a guide for judging the feasibility of landing operations for each type of landing craft.

1102. MODIFIED SURF INDEX CALCULATION. When applied to a known or forecast surf condition, the modified surf index calculation provides the commander with an objective method of arriving at a safe and reasonable decision with respect to committing landing craft and amphibious vehicles. Limiting surf conditions for training operations shall be set by the commander concerned. These limits shall not exceed conditions acceptable for routine operations as calculated by the objective method described below. CAUTION: Surf capability of landing craft and amphibious vehicles computed by this method assumes such craft are in good condition. It does not take into consideration the state of training of personnel or the state of maintenance of equipment.

1103. MODIFIED SURF INDEX CALCULATION SHEET

SUROB/SURFCST: Date-Time _____
Beach _____

SIGNIFICANT BREAKER HEIGHT (ALFA) _____ Feet
Enter Significant Breaker Height in feet _____

BREAKER PERIOD (Charlie) _____ Seconds
Enter value from Breaker Period
Modification Table _____

BREAKER TYPE (Delta) _____
_____ %Spilling _____ %Plunging _____ %Surging
Enter value from Spilling Breaker or
Surging Breaker Modification Table _____

BREAKER ANGLE (Echo) _____ Degrees
Enter value from Wave Angle
Modification Table (a) _____

LITTORAL CURRENT (Foxtrot) _____ Knots
Enter value from Littoral Current
Modification Table (b) _____

Enter the larger of (a) and (b) from above _____

REL WIND (Hotel) _____ Kts _____ Deg Onshore/Offshore
Enter value from
Wind Modification Table _____

SECONDARY WAVE HEIGHT (Hotel) _____ Feet
Enter Secondary wave height in feet
(if applicable) _____

MODIFIED SURF INDEX
Sum all entries in the right hand column to
obtain Modified Surf Index _____

The Modified Surf Limit is the maximum that should be attempted for routine operations. If the Modified Surf Index exceeds the Modified Surf Limit of the craft or vehicle, the landing is not feasible without increasing the casualty rate. If the Modified Surf Index is less than the Modified Surf Limit of the craft, the landing is feasible.

15 APR 1997

1104. MODIFIED SURF INDEX CALCULATION TABLES

Breaker Period Modification Table

Breaker Period (sec)	17	0.0	0.0	0.0	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.8	-1.0
	16	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.5	-0.7
	15	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3
	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	13	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3
	12	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.7
	11	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0
	10	0.0	0.0	0.1	0.1	0.2	0.3	0.5	0.7	0.9	1.1	1.3
	9	0.0	0.0	0.1	0.1	0.3	0.3	0.6	0.8	1.1	1.3	1.7
	8	0.0	0.0	0.1	0.2	0.3	0.5	0.7	1.0	1.3	1.6	2.0
		0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	= 5

Breaker Height (feet)

Spilling Breaker Modification Table

Percent Spilling Breakers	100	0.0	-0.1	-0.2	-0.5	-0.8	-1.3	-1.8	-2.5	-3.2	-4.1	-5.0
	90	0.0	0.0	-0.2	-0.4	-0.7	-1.1	-1.6	-2.2	-2.9	-3.6	-4.5
	80	0.0	0.0	-0.2	-0.4	-0.6	-1.0	-1.4	-2.0	-2.6	-3.2	-4.0
	70	0.0	0.0	-0.1	-0.3	-0.6	-0.9	-1.3	-1.7	-2.2	-2.8	-3.5
	60	0.0	0.0	-0.1	-0.3	-0.5	-0.8	-1.1	-1.5	-1.9	-2.4	-3.0
	50	0.0	0.0	-0.1	-0.2	-0.4	-0.6	-0.9	-1.2	-1.6	-2.0	-2.5
	40	0.0	0.0	-0.1	-0.2	-0.3	-0.5	-0.7	-1.0	-1.3	-1.6	-2.0
	30	0.0	0.0	-0.1	-0.1	-0.2	-0.4	-0.5	-0.7	-1.0	-1.2	-1.5
	20	0.0	0.0	0.0	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.8	-1.0
	10	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.5
	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	= 5

Breaker Height (feet)

(Note: No Modification for Plunging Breakers)

Surging Breaker Modification Table

Percent Surging Breakers	100	0.0	0.1	0.2	0.5	0.8	1.3	1.8	2.5	3.2	4.1	5.0
	90	0.0	0.0	0.2	0.4	0.8	1.2	1.7	2.3	3.0	3.8	4.7
	80	0.0	0.0	0.2	0.4	0.7	1.1	1.6	2.2	2.9	3.6	4.5
	70	0.0	0.0	0.2	0.4	0.6	1.0	1.5	2.0	2.7	3.4	4.2
	60	0.0	0.0	0.2	0.3	0.6	1.0	1.4	1.9	2.5	3.1	3.9
	50	0.0	0.0	0.1	0.3	0.6	0.9	1.3	1.7	2.3	2.9	3.5
	40	0.0	0.0	0.1	0.3	0.5	0.8	1.1	1.5	2.0	2.6	3.2
	30	0.0	0.0	0.1	0.2	0.4	0.7	1.0	1.3	1.8	2.2	2.7
	20	0.0	0.0	0.1	0.2	0.4	0.6	0.8	1.1	1.4	1.8	2.2
	10	0.0	0.0	0.1	0.1	0.3	0.4	0.6	0.7	1.0	1.3	1.6
	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	= 5

Breaker Height (feet)

(Note: Surging breakers should only occur on beaches with steep gradients and should not occur with spilling breakers. See Figure 4-1)

9 JAN 1987

Wave Angle Modification Table

	40	0.0	0.1	0.3	0.7	1.3	2.0	2.9	3.9	5.1	6.5	8.0
	35	0.0	0.1	0.3	0.6	1.1	1.8	2.5	3.4	4.5	5.7	7.0
	30	0.0	0.1	0.2	0.5	1.0	1.5	2.2	2.9	3.8	4.9	6.0
Wave Angle (deg)	25	0.0	0.1	0.2	0.5	0.8	1.3	1.8	2.5	3.2	4.1	5.0
	20	0.0	0.0	0.2	0.4	0.6	1.0	1.4	2.0	2.6	3.2	4.0
	15	0.0	0.0	0.1	0.3	0.5	0.8	1.1	1.5	1.9	2.4	3.0
	10	0.0	0.0	0.1	0.2	0.3	0.5	0.7	1.0	1.3	1.6	2.0
	5	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0
	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	= 5
		Breaker Height (feet)										

Littoral Current Modification Table

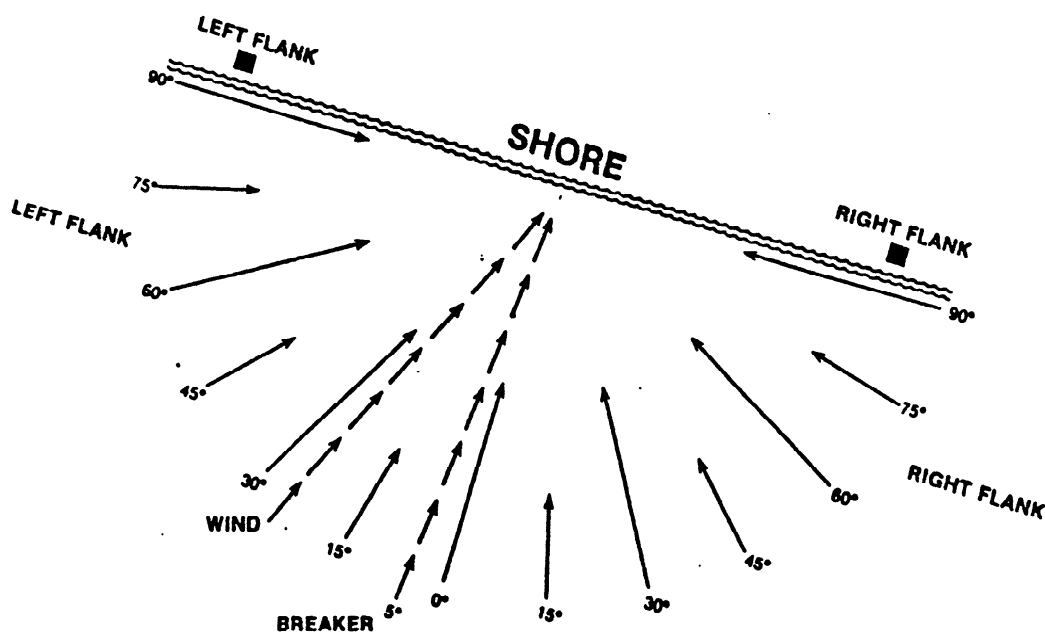
Current (knots) Modification

0.0	-----	0.0
0.1		0.3
0.2		0.6
0.3		0.9
0.4		1.2
0.5		1.5
0.6		1.8
0.7		2.1
0.8		2.4
0.9		2.7
1.0	-----	3.0
1.1		3.3
1.2		3.6
1.3		3.9
1.4		4.2
1.5		4.5
1.6		4.8
1.7		5.1
1.8		5.4
1.9		5.7
2.0	-----	6.0
2.1		6.3
2.2		6.6
2.3		6.9
2.4		7.2
2.5		7.5
2.6		7.8
2.7		8.1
2.8		8.4
2.9		8.7
3.0	-----	9.0

Wind Modification Tables

		Onshore			Offshore		
Wind Speed (knots)	36-40	2.0	3.0	4.0	1.5	2.0	4.0
	30-35	1.5	2.0	3.0	1.0	1.5	3.0
	26-30	1.0	1.5	2.0	0.5	1.0	2.0
	21-25	0.5	1.0	1.5	0.0	0.5	1.5
	16-20	0.0	0.5	1.0	0.0	0.0	1.0
	11-15	0.0	0.5	1.0	0.0	0.0	1.0
	6-10	0.0	0.0	0.5	0.0	0.0	0.5
	0-5	0.0	0.0	0.0	0.0	0.0	0.0
		0-30	30-60	60-90	0-30	30-60	60-90
Angle Relative to Beach (deg)							

The relative angle of the breaker (wind) to the beach is the acute angle, in degrees, between the direction of breaker (wind) and a line normal to the beach edge. Also indicate the flank toward which the breaker (wind) is moving. The observation point of view is from seaward to shoreward. For the relative wind also indicate whether the wind is blowing onshore or offshore. In Figure 11-1, the angle of the breaker would be reported as 5 degrees toward right flank, and the wind would be 25 degrees toward right flank onshore.



SURF/WIND ANGLE DIAGRAM

FIGURE 11-1

2 JAN 1967

1105. MODIFIED SURF LIMITS FOR LANDING CRAFT

Modified Surf Limits

Craft/Vehicle	Modified Surf Limit
LCM 6	8
LCM 8	8
LCU	12
LCVP	5
LVTP-5	8
LVTP-7	see below
LARC	6
CAUSEWAY (3x15)	6
LARC V	9
SELF PROPELLED	7
BARGE (Pontoon)	7
TRUCK 2 1/2 TON, 6x6	
Amphibian (W/Canopy)	

Modified Surf Limits for LVTP-7

The following modified surf limits for LVTP-7 training operations are based on three load conditions:

1. Combat Load (CL) of 10,000 lbs.
2. Troop Load (TL) of 5,600 lbs.
3. Combat Equipped (CE) with no load.

LOAD	MOD SURF LIMIT	MINIMUM WAVE PERIOD
	100 Percent Plunging Surf	
CL	6	9 sec
TL	6	9 sec
CE	6	13 sec
	50 Percent Plunging, 50 Percent Spilling Surf	
CL	6	8 sec
TL	6	8 sec
CE	6	10 sec
	100 Percent Spilling Surf	
CL	6	5 sec
TL	6	5 sec
CE	6	7 sec

Safety Notes:

1. For student Basic MOS 1800 operations (First Time Drivers) recommend training be conducted with a modified surf limit of four and include six outbound and six inbound transits of the surf zone.

2. Planning for combat operations should be predicted on LVTP-7 demonstrated capability for negotiating ten foot plunging waves in CL and TL conditions and eight foot plunging waves in CE condition.

3. The above figures are also applicable to LVTC-7 and LVTR-7.

1106. MAXIMUM SURF CAPABILITIES FOR LCAC. The Modified Surf Index is not applicable to the LCAC. Limiting conditions for operating the LCAC in the surf zone is based on load size and significant breaker height only. See Chapters 7 and 12 for additional information on the LCAC.

<u>LOAD</u>	<u>SIG. BREAKER HEIGHT</u>
75 tons overload	0-4 feet
60 tons normal payload	4-8 feet
45 tons reduced payload	8-12 feet

CHAPTER 12

SURF ZONE TRANSITIONS FOR LCAC

1201. LCAC LIMITS IN THE SURF ZONE. The operational considerations affecting movement of the LCAC from water to land and back to water are contained in this section including surf penetration in both directions. Operations through the surf are summarized in Table 12-1. The LCAC is designed to operate in waves up to 8 feet. Operations in surf up to 12 feet are possible and will depend upon the capability of the operator to avoid craft structural damage.

TABLE 12-1

LCAC on Cushion Operation in Surf

Characteristic	Low Surf	Med Surf	High Surf
Height	0-4 ft	4-8 ft	8-12 ft
Payload	60 tons (75 tons overload)	60 tons	Reduce payload to 45 tons for 12-ft or higher surf. Negotiation of high surf depends on skill of Operator (note 1)
Heading to Surf Line	90 \pm 45	90 \pm 10	90 \pm 10
Max Speed During Beach Approaches	50 kn (note 1)	30 kn (note 1)	20 kn (note 1)
Max Speed During Beach Departures	30 kn (note 2)	20 kn	10 kn

Note 1 - Inside surf line, craft speed is adjusted to coincide with wave speed.

2 - Speed should be reduced with a steep beach gradient to avoid plow-in and hard structure damage.

1202. LCAC BEACH APPROACH. Due to the vulnerability of the propellers, it has to be understood that surf operations with the LCAC have certain dissimilarities from standard landing craft. Particularly on the approach to the beach there is a great risk of taking plunging surf through the propellers causing loss of craft. Study of the wave action is required to ensure following behind a wave, and never allow a wave to overtake the craft and break over the stern. The major factor to take into account is the surf speed and available landing area. Once clear of the water and on land the craft will accelerate rapidly, possibly causing a hazardous situation of getting the craft stopped in the available landing area. The water to land transition for the LCAC is summarized in Figure 12-1.

1203. LCAC BEACH DEPARTURE. Due to the vulnerability of the propellers the LCAC will always enter the surf bow-on. The major consideration on the departure is the gradient of the beach and the breaker height. Plow-in, the collapse of the forward skirt of the LCAC, can result with the possibility of hard structure impact, and damage to the craft. The danger of plow-in will increase as breaker height increases or the gradient of the beach steepens. The LCAC can be operated satisfactorily in a plunging surf. Prior to beach departure a study of the wave patterns and frequency is required so as to arrive at the breaker line during a reduced wave period. An angle of approach to the breaker line of 10 degrees is required in heavy surf to reduce the possibility of plow-in. The land to water transition for the LCAC is summarized in Figure 12-2. The maximum transition speed is 30 knots.

TRANSITION FROM WATER TO LAND



APPROACHING SURF*

REDUCE SPEED
TO LESS THAN
30 KNOTS

MAINTAIN CRUISE MODE -
BOW THRUST FORWARD
PITCH VERNIER SWITCH ON

IN SURF*

FOR BEST RIDE,
ADJUST SPEED TO
FOLLOW WAVE CREST

USE ALL CONTROLS TO
MAINTAIN HEADING
AND COURSE NORMAL TO
BEACH (MAXIMUM
DEVIATION $\pm 10^\circ$)

IN SURF UP TO 8 FT,
SPEEDS TO 30 KNOTS
PERMISSIBLE BUT
RIDE MAY BE POORER

USE CONTROL COLUMN
MOVEMENT TO CONTROL
SPEED

APPROACHING BEACH

AFTER WAVE HAS PLUNGED,
THE TUMBLING WATER IS
OVERTAKEN. INCREASE
SPEED TO ACCELERATE UP
BEACH

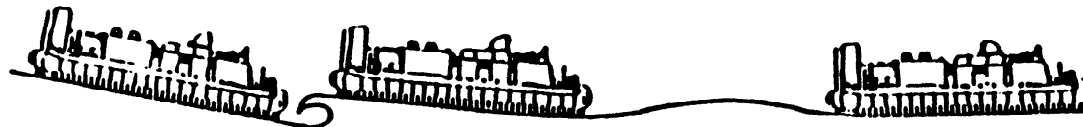
ANTICIPATE DECREASE IN DRAG
IN FROTHY WATER-BEACH INTERFACE.
ANTICIPATE NEED FOR INCREASED
THRUST IF BEACH HAS A STEEP
SLOPE

ANTICIPATE TENDENCY TO
ACCELERATE AS BEACH
FLATTENS. SHIFT TO
MANEUVERING MODE FOR
LOW-SPEED MANEUVERING

*MEDIUM SURF HEIGHT IS 4 TO 8 FEET.

Figure 12-1. LCAC Water-to-Land Transition

TRANSITION FROM LAND TO WATER



COMING OFF BEACH

COME ON CUSION IN
MANEUVER MODE

TIME SURF ENTRANCE TO MISS
LARGER CRESTING WATER

SWITCH TO CRUISE MODE
AND APPROACH SURF AS
SPEED INCREASES -
V < 20 KNOTS

SWITCH PITCH VERNIER ON

IN SURF*

MAINTAIN V < 20 KNOTS
ANTICIPATE HIGH DRAG
IN FROTHY WATER -
CRAFT WILL BE SLUGGISH

USE ALL CONTROLS TO
MAINTAIN HEADING AND
COURSE NORMAL TO BEACH
(MAXIMUM DEVIATION $\pm 10^\circ$)

EASE OFF THRUST IF
CONTACT WITH WAVE AT
MOMENT OF PLUNGING IS
UNAVOIDABLE

USE CONTROL COLUMN
MOVEMENT TO CONTROL
SPEED

CLEAR OF SURF*

SET CRUISE MODE

ACCELERATE TO
CRUISE SPEED

*MEDIUM SURF HEIGHT IS 4 to 8 FEET.

Figure 12-2. LCAC Land-to-Water Transition

CHAPTER 13

SUROB BREVITY CODE

1301. BACKGROUND AND DISCUSSION. The plain language transmission of SUROBS, as described in Chapter 9, results in tests of an average 40 groups in length. These reports are usually transmitted over the Beachmaster Coordination circuit and each report takes about five minutes to transmit. A detailed examination of the text format of a SUROB revealed that all of the parameters reported are essential but that many of the adjectives and paragraphing indicators are superfluous. By use of a standard format, known to both the sender and receiver, it is possible to eliminate the constants of the report (i.e., paragraph headings; measurement units, etc.). Continuing a step further, it is apparent that by use of standard tables of values, a simple "Brevity Code" is practicable. This "Brevity Code", which is a standardized method of encoding and transmitting surf observations (SUROBS) by voice or flashing light when brevity is essential, should be referenced in weather annexes of Amphibious Operation Orders.

1302. OBSERVATIONS. Observations will be made in accordance with Chapter 10. Particular attention will be paid to the best determination of wind direction and speed (See Tab A). Visibility, estimated ceiling, as well as wind direction and speed will always be included in paragraph Hotel of the SUROB.

1303. ENCODING AND DECODING

a. Coding Rules. The encoding of SUROBS for transmission and decoding for analysis will be done in accordance with the code tables and instructions of this Appendix. Only those reports to be initiated on visual or voice channels will be encoded. Suspension, cancellation, and resumption of coding instructions will be signalled by CATF or the Scene Commander using the following signals:

<u>Signal</u>	<u>Meaning</u>
"Suspend WS"	Use normal voice procedures, do NOT encode SUROB text for the next report only.
"Cancel WS"	Use normal voice procedures for all subsequent reports, do not encode text until ordered.
"Resume WS"	Encode Surob texts for all subsequent reports.

b. Encoding Procedures. This subparagraph lists the positions of each letter code corresponding to each element of the SUROB report within the groups of the message text. It also gives the instructions for determining the correct letter code to use from the Encode Table.

ENCODE TABLE

<u>Plain Text</u> <u>SUROB Report Element</u>	<u>Coded Text</u> <u>Group No.</u>	<u>Position</u> <u>of Letters</u> <u>in Group</u>	<u>Instructions</u>
SUROB	I	1, 2	Always encoded "WS". This group serves as a report indicator.
NUMBER BEACH	Omitted I	N.A. 3	This code element is established by CATF of the Scene Commander. It is a single alphabetic beach designator which may or may not change according to a local schedule. This letter may correspond to the one in use for reporting SUROB's to the cognizant NOCC/NOCP.
DTG of Observation	I	4, 5	Position number 4 and 5 elements are selected from column 1 of the encode table. Encode last digit of date and closest whole hour local time respectively. Example: VIE 2.0 of 2nd, 12th and

22nd of month and for 0130 to 0229, 1130 to 1229, and 2130 to 2229 respectively. Do not use code letters for 10, 11, 12 or over 12.

Plain Text SUROB Report Element	Coded Text Group No.	Position of Letters in Group	Instructions
ALFA ____ PT ____ (Significant breaker height to nearest half foot)	II	1	The significant breaker height is encoded from Column 1.
BRAVO ____ PT ____ (Maximum breaker height to nearest half foot)	II	2	The maximum breaker height is encoded from column 1.
CHARLIE ____ PT ____ (Period to nearest half second)	II	3	The breaker period, rounded to the nearest whole second, is encoded from column 2.
DELTA ____ PLUNGING ____	II	4,5	Only percent plunging and spilling breakers be coded. Zero percent of either will be indicated by the appropriate element. Code elements will be selected from column 1 disregarding the decimal point. Example: For 55%, use code element for 5.5. Elements coded need not add to 100%; difference between 100% and sum of code elements is assumed to be percent surging breakers.
ECHO ____ TOWARD ____	III	1, 2	The Group III, position number 1 element, is the breaker angle in tens of degrees rounded to the nearest 5 degrees. Select code element from column using the closest given value. Example: For 12 degree angle use 1.0, for 23 degree angle, use 2.5. Encode "direct" or "parallel to beach" as zero degrees (0.0=0 degrees). The position number 2 element is the name of the flank toward which the breaker angle opens, looking from seaward. Encode the direction from column 3 elements: Left flank = L, Right flank = R, Parallel = P.
FOXTROT ____ PT ____ KT	III	3,4	The position number 3 element is selected from column 3, using the decimal point to describe the current speed to the nearest half knot. The position number 4 element is the name of the flank toward which the current is flowing as observed from seaward. Encode the direction from column 3 elements: Left flank = L, Right flank = R, No current = P.
GOLF ____ TO ____ LINES	III	5	SUROB element GOLF has two code elements. Group III, position 5 describes the maximum number of lines of surf and is selected from column 1.

IN ____ FT ____	IV	1	The second element of GOLF describes the width of the surf zone. This Group IV, position 1 element is selected from column 3 by dropping the last digit from the width of the surf zone and using the closest element. Example: For 125 feet use 11-20; for 270 feet use 26-30, 557 feet use over 50.
HOTEL	IV	2	Position number 2 is the relative sector from which the wind is blowing. (See Tab A.) Position number 2 is encoded from column 3.
Wind Speed	IV	3	Position number 3 is wind speed. Select the appropriate speed range from column 3.
Plain Text SUROB Report Element	Coded Text Group No.	Position of Letters in Group	Instructions
Observers Evaluation	IV	4	Position number 4 is the observers evaluation of boating conditions. This element is encoded from column 3.
Visibility	IV	5	Position number 5 is the visibility in miles to the nearest half mile over 1 mile and to the nearest quarter mile under 1 mile. Position number 5 is selected from column 1.
HOTEL Ceiling	V	1	Group V, Position number 1 is the estimated ceiling (more than .6 sky cover) in hundreds of feet. It is selected from column 2. Example: For 300 feet, use 3.0, for 700 feet, use 7.0, for 1000 feet, use 10.0, for 2500 feet, use 20-30, for 6000 feet use over 50. If there is not .6 cloud cover, code as "L".
End of Report/ Secondary Surf	V	2	Position number 2 is usually the last code element and indicates "end of report" (encoded from column). If secondary surf is present, encode "Secondary surf follows" from column 3 and continue with SUROB report elements ALFA through GOLF except for width of surf zone. This will add two groups to text.

1304. TEXT FORMAT. The text format is shown in Tab B.

1305. SAMPLE MESSAGE. The following sample message is given to demonstrate the use of the ENCODED TABLE (Tab C) in translating a plain text message into an encoded one.

<u>Plain Text Transmission</u>	<u>Coded Table Column Letter</u>	<u>Encoded Transmission</u>
(Voice Call) appropriate ship	---	(Voice Call)
This is (Voice Call) observer ashore	---	(Voice Call)
MSG FOLLOWS	---	The heading is not inserted in the voice transmission by the reporting unit ashore.
IMMEDIATE TIME	---	
071600 JAN 70	---	
FM (Voice Call) observer ashore TO CATF or SUROB reporting ships as directed	---	
BREAK		BREAK

UNCLAS

SUROB	---	WS	WSKCC
NUMBER 5	---		
BEACH KILO	---	K	
070727U	1	CC	

ALFA 2 PT 5	1	S	SUGGY
BRAVO 6 PT 5	1	U	
CHARLIE 13 PT 5	2	G	
DELTA 45 PLUNGING	1	G	
35 SPILLING	1	Y	
20 SURGING	---	---	

<u>Plain Text Transmission</u>	<u>Coded Table Column Letter</u>	<u>Encoded Transmission</u>
ECHO 15	1	I
TOWARD LEFT FLANK	3	L
FOXTROT 1 PT 0	1	E
TOWARD LEFT FLANK	3	L
GOLF 5 TO 7 LINES	1	C

(GOLF IN 245 FT	3	J	JYBXC
HOTEL WIND 35 DEG ONTO BEACH			
TOWARD RIGHT FLANK	3	Y	
16 KNOTS	3	B	
SUITABLE FOR LCM's AND LARGER	3	X	
VISIBILITY 7 MILES	1	C	

(HOTEL) CEILING ESTIMATED 1200 FT	2	A	AW
NO SECONDARY SURF	3	W	

BREAK, OVER

BREAK, OVER

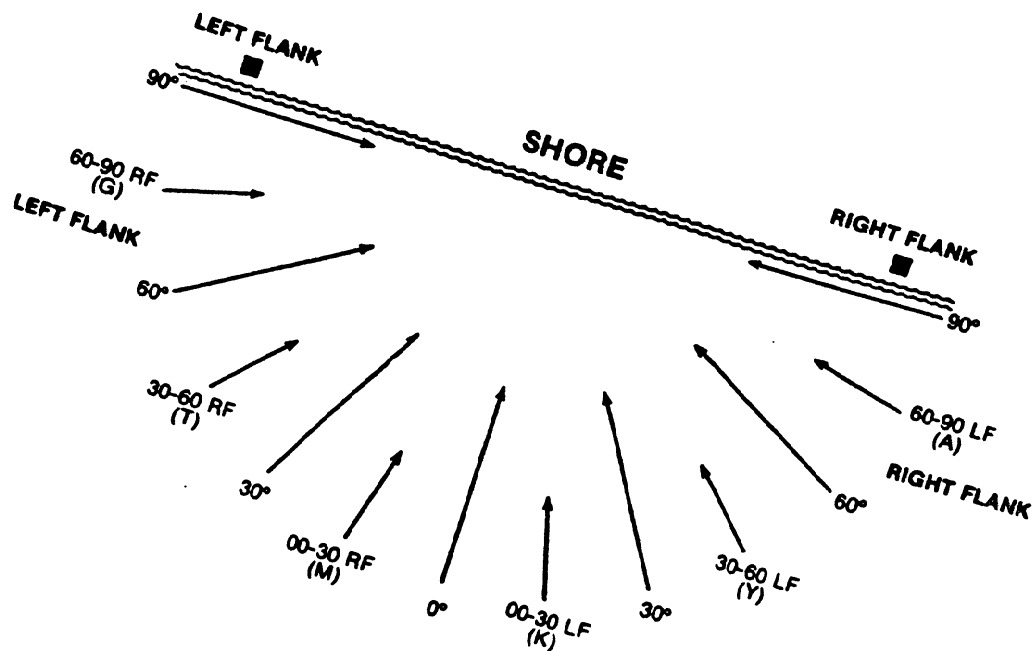
The encoded voice message when completed appears as follows:

(Voice Call) CATF or SUROB reporting ship this is (Voice Call) observer ashore
BREAK WSKCC SUGGY ILELC JYBXC AW BREAK, OVER

2 JAN 1997

1306. TRANSMISSION INSTRUCTION. Brevity encoded SUROBS (WS Reports) are considered tactical information. Expeditionary handling of WS reports is required to make timely use of this perishable information. Reports originated or transmitted on voice or flashing light communications channels are to be relayed in the coded format. Routing and handling instructions within any task organization will be promulgated by the appropriate commander. The designated SUROB Reporting Ship is tasked to decode each WS report to plain text and transmit it to the Naval Oceanography Command Center or Facility providing environmental services support.

TAB A



WIND ANGLE DIAGRAM

1 JAN 1987

TAB BBREVITY CODE SUROB MESSAGE FORMAT

1. The complete symbolic form of the "Brevity Code" SUROB message is:

WSB T T ABCD D E E F F G G H H H H H H XXX
 a d h 1 2 1 2 1 2 1 2 1 2 3 4 5 6

Encode Table Column No.

WS =	Indicator Characters	NA
B =	Alphabetical Beach Name as designated by CATF	NA
a		
T =	Date (Last digit only - e.g., use code equivalent for 2 for 2, 12, 22)	1
d		
T =	Hour (Closest whole hour local time) (Last digit only e.g., use code equivalent for 2 for 0130 to 0229, 1130 to 1229, 2130 to 2229)	
h		
A =	Significant Breaker Height. The mean value of the one third highest breakers on the beach measured to the nearest foot	1
B =	Maximum Breaker Height. The highest breaker observed during the period measured to the nearest foot.	1
C =	Period. The time interval between breakers measured to the nearest second.	2
D =	Plunging Breakers, Numerical percentage of (Disregard decimal point in 1 encode table).	1
D =	Spilling Breakers, Numerical percentage of (Disregard decimal point 2 in encode table).	1
E =	Angle of breakers with the beach in tens of degrees rounded to the nearest 1 five degrees. (Disregard decimal point in encode table.) Encode direct or parallel to the beach as zero degrees.	1
E =	Flank toward which the current is flowing as observed from seaward.	3
2		
F =	Speed of Littoral Current, measured to the nearest half knot.	1
1		
F =	Flank toward which the current is flowing as observed from seaward.	3
2		
G =	Maximum number of lines of surf.	1
1		
G =	Width of Surf Zone in tens of feet. (e.g., for 125 feet, use 11-20; for 270 feet, use 26-30; etc.)	3
2		
H =	Relative sector from which the wind is blowing. See Tab A.	3
1		
H =	Wind speed in knots.	3
2		
H =	Observers recommendation on boating conditions.	3
3		
H =	Visibility in miles.	1
4		

- H = Estimated ceiling (.6 or more of sky covered with clouds) (Read column 2
5 in hundreds of feet, i.e., 3.0 = 300 ft; 7.0 = 700 ft; 10 = 1000 ft. 2
- H = End of report indicator OR secondary surf indicator. If secondary surf
6 significant, follows with code elements ABCD D E E F F G (See Tab E). 3
1 2 1 2 1 2 1

TAB C
ENCODE TABLE FOR BREVITY CODE

Code Letter	1	Column Number 2	3
Q	0.0	Less than 3.0	0-10
B	0.25	3.0	11-20
J	0.5	4.0	21-25
H	0.75	5.0	26-30
E	1.0	6.0	31-35
I	1.5	7.0	36-40
O	2.0	8.0	41-50
S	2.5	9.0	Over 50
K	3.0	10.0	00-30LF
Y	3.5	11.0	30-60LF
A	4.0	12.0	60-90LF
G	4.5	13.0	60-90RF
T	5.0	14.0	30-60RF
M	5.5	15.0	00-30RF
Z	6.0	16.0	Off Shore
U	6.5	17.0	Safe for all craft
C	7.0	18.0	Unsafe for PAPA boats
X	7.5	19.0	LCM and larger
D	8.0	20.0	LCU only
N	8.5	20-30	- - - -
V	9.0	30-40	- - - -
P	9.5	40-50	Parallel/No current
R	10.0	Over 50	Right Flank
L	11.0	Less than .6 cloud cover	Left Flank
W	12.0	- - -	End of Report
F	Over 12	- - -	Secondary Surf follows

2 JUN 1967

TAB D

DECODE TABLE FOR BREVITY CODE

Code Letter	Column Number		
	1	2	3
A	4.0	12.0	60-90LF
B	0.25	3.0	11-20
C	7.0	18.0	Unsafe for PAPA boats
D	8.0	20.0	LCU only
E	1.0	6.0	31-35
F	Over 12		Secondary Surf follows
G	4.5	13.0	60-90RF
H	0.75	5.0	26-30
I	1.5	7.0	36-40
J	0.5	4.0	21-25
K	3.0	10.0	00-30
L	11.0	Less than .6 cloud cover	Left Flank
M	5.5	15.0	00-30RF
N	8.5	, 20-30	- - - -
O	2.0	8.0	41-50
P	9.5	40-50	Parallel/no current
Q	0.0	Less than 3.0	0-10
R	10.0	Over 50	Right Flank
S	2.5	9.0	Over 50
T	5.0	14.0	30-60RF
U	6.5	17.0	Safe for all carft
V	9.0	30-40	- - - -
W	12.0	- - -	End of report
X	7.5	19.0	LCM and larger
Y	3.5	11.0	30-60LF
Z	6.0	16.0	Offshore

3 JAN 1967

TAB E

DECODE FORM FOR BREVITY CODE SUROB

BREVITY CODE SUROB

TOR: _____

W	S	B	T	T	A	B	C	D	D	E	E	F	F	G
		a	d	h				1	2	1	2	1	2	1
								XXX (_____)						
G	H	H	H	H	H	H		A	B	C	D	D	E	E F F G
2	1	2	3	4	5						1	2	1	2 1 2 1

Code Symbol	Decode Table Column No.	Decode Value	Parameter
WS	NA	"Brevity Code" SUROB	Indicator Characters
B a	NA	_____	Beach Name (Alphabetical) as assigned by CATF
T d	1	_____	Date
T h	1	_____	Hour (Local Time)

A	1	_____ PT	Significant Breaker Height
B	1	_____ PT	Maximum breaker Height
C	2	_____ Seconds	Period
D 1	1	_____ %	Percentage Plunging Breakers
D 2	1	_____ %	Percentage Spilling Breakers
(100% - (D ₁ + D ₂)) = _____ %			Percentage Surging Breakers

E 1	1	_____ Degrees	Breaker Angle
E 2	3	Right/Left/Parallel	Flank towards which breaker angle opens looking from seaward.
F 1	1	_____ PT Knots	Speed of Littoral Current
F 2	3	Right/Left/No current	Flank towards which current is flowing as observed from seaward.
G 1	1	_____	Maximum number of lines of surf.

G 2	3	_____ Feet	Width of surf zone (in tens of feet)

H	3	_____	Relative sector and Flank from which wind is blowing. See Tab A.
1			
H	3	_____ Knots	Wind Speed
2			
H	#	<u>Safe for all craft.</u> <u>Unsafe for PAPA boats.</u> <u>LCM and larger.</u> <u>LCU only.</u>	Observer's recommendation on boating conditions.
H	1	_____ Miles	Visibility
4			
H	2	100's of feet	Estimated Ceiling
5			
H	3	End of Report	Indicator Characters
6			

SECONDARY SURF

A	1	_____ PT	Significant Breaker Height
B	1	_____ PT	Maximum breaker Height
C	2	_____ Seconds	Period
D	1	_____ %	Percentage Plunging Breakers
1			
D	1	_____ %	Percentage Spilling Breakers
2			
(100% - (D ₁ + D ₂) = _____ %			Percentage Surging Breakers

E	1	_____ Degrees	Breaker Angle
1			
E	3	Right/Left/Parallel	Flank towards which breaker angle opens looking from seaward.
2			
F	1	_____ PT Knots	Speed of Littoral Current
1			
F	3	Right/Left/No current	Flank towards which current is flowing as observed from seaward.
2			
G	1	_____	Maximum number of lines of surf.
1			

APPENDIX A

FURTHER SOURCES OF INFORMATION ON SEA/SWELL/SURF

N.O.P. 234	"Breakers and Surf, Principles in Forecasting"
N.O.P. 602	"Wind Waves at Sea, Breakers and Surf"
N.O.P. 603	"Practical Methods for Observing and Forecasting Ocean Waves by Spectra and Statistics" AD739935
N.O.P. 604	"Techniques of Forecasting Wind Waves and Swell"
N.O.P. 605	"Graphical Construction of Wave Refraction Diagrams"

Navy Weather Research Facility Publication No. 36-1264-099 "Surf Forecasting"

NAVWEPS 50-1P-547 "Oceanography for the Navy Meteorologist"

NOTE: Some Pubs are no longer effective, and are not in print, but can still provide suitable information if available.